SCOPING AND REVIEW OF FORESTRY DATA AND REDD+ IN THE PHILIPPINES

THE AILEG PROJECT

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FINAL REPORT - SCOPING AND REVIEW OF FORESTRY DATA AND REDD+ IN THE PHILIPPINES

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ACRONYMS

A&D	Alienable and Disposable
ADB	Asian Development Bank
AGB	Aboveground Biomass
AILEG	Analysis and Investment for Low-Emission Growth
ALOS	Advanced Land Observation Satellite
B+ WISER	Biodiversity and Watersheds Improved for Stronger Economy and Ecosystem Resilience
BCEF	Biomass Conversion and Expansion Factor
CBERS/HRCCD	China-Brazil Earth Resources Satellite/High Resolution CCD Camera
CCBA	Climate, Community & Biodiversity Alliance
CCC	Climate Change Commission
CO_2	Carbon dioxide
COP	Conference of the Parties
DBH	Diameter at Breast Height
DENR	Department of Environment and Natural Resources
E3	Bureau for Economic Growth, Education and Environment
EC-LEDS	Enhancing Capacity for Low Emission Development Strategies
EnviSat MERIS	European Space Agency Environmental research satellite/ MEdium Resolution Imaging Spectrometer
EO	Executive Order
EP	Office of Economic Policy (USAID)
EPA	U.S. Environmental Protection Agency
ESSC	Environmental Science for Social Change
FAO	Food and Agriculture Organization of the United Nations
FCPF	Forest Carbon Partnership Facility
FFI	Flora and Fauna International
FMB	Forest Management Bureau
FRA	Forest Resources Assessment (UN Food and Agriculture Organization)
FRI	Forest Resource Inventory
GCC	Office of Global Climate Change (USAID)
GHG	Greenhouse gas
GIS	Geographic information systems
GIZ	*Deutsche Gesellschaft für Internationale Zusammenarbeit/* German International Cooperation Agency
GL-AFOLU	Guidelines for National Greenhouse Gas Inventories for Agriculture, Forestry, and Other Land Uses
GOFC-GOLD	Global Observation of Forest Cover and Land Dynamics
GPG	Good Practice Guidance
GPH	Government of the Republic of the Philippines
IP	Indigenous People
IPCC	Intergovernmental Panel on Climate Change

IRS AWiFs	Indian Remote Sensing (IRS) Advanced Wide Field Sensor (AWiFS)
Landsat TM/ETM	LandSatellite Thematic/Enhanced Thematic Mapper
LEAD	Low-Emission Asia Development
LGU	Local Government Unit
LIDAR	Light Detection and Ranging
LISSS	Linear Imaging Self Scanning Sensor
LULUCF	Land Use, Land Use Change and Forestry
LUS	Land-Use Section
MAI	Mean Annual Increment
MODIS	Moderate-Resolution Imaging Spectroradiometer
MOU	Memorandum of Understanding
MRV	Measurement, Reporting, and Verification
NAMRIA	National Mapping and Resource Information Authority
NFSCC	National Framework Strategy on Climate Change
NTFP	Non-Timber Forest Products
NGO	Non-governmental organization
NGP	National Greening Program
PNRPS	Philippine National REDD+ Strategy
PO	People's Organizations
REDD	Reducing Emissions from Deforestation and Degradation
REDD+	Reducing Emissions from Deforestation and Degradation plus fostering conservation, sustainable management of forests, and enhancement of forest carbon stocks
REL/RL	Reference Emission Level/Reference Level
RP	Republic of the Philippines
SBSTA	Subsidiary Body for Scientific and Technological Advice
SPOT-VGT HRV	Système pour l'Observation de la Terre-Végétation/(High Resolution Visible)
UN-REDD	United Nations Collaborative Programme on Reducing Emissions from Deforestation
UNDP	United Nations Development Programme
UNEP	United Nations Environment Programme
UNFCCC	United Nations Framework Convention on Climate Change
USAID	United States Agency for International Development
VOB	Volume over Bark

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The AILEG Forestry data and REDD+ Phase I scoping and review report was prepared by Abt Associates consultant Dr. Guillermo Mendoza. Ms. Felicidad Narvaez, AILEG Coordinator from Abt Associates provided invaluable assistance in facilitating meetings during the AILEG trips to the Philippines. Valuable review of the report was provided by Oliver Agoncillo and Dr. Eric Hyman, Enterprise Development Officer/Capacity Building of USAID/E3/EP; consultant Dr. Ernesto Guiang; and Ms. Lindsay Kohlhoff, AILEG Climate Change Specialist, of Abt Associates.

EXECUTIVE SUMMARY

This briefing document describes the results of the scoping work under the Analysis and Investment for Low-Emission Growth (AILEG) Project, Philippines Activity 2, Energy and Forestry Sector Data Assessments and Economic Analysis, Task 2: Forestry Data and REDD+[1] Assessment (Forestry Data). The primary goal of this task is "to help the Philippines move towards a more robust forestry data collection system to support [greenhouse gas (GHG)] inventories and other data needed to advance REDD+ schemes in the country." To achieve this goal, the task has the following objectives: (1) to review the REDD+ program in the Philippines, and (2) to provide an in-depth assessment of the forestry data currently being collected in the Philippines and to identify data gaps, processes, and tools to manage data.

This briefing document serves as a guide for the assessment of forestry data and the REDD+ program in the Philippines. It contains a brief review of the REDD+ program and forestry data requirements needed to implement REDD+ consistent with the provisions and recommendations from the United Nations Framework Convention on Climate Change/Intergovernmental Panel on Climate Change (UNFCCC/IPCC) and provides a summary of the REDD+ initiatives in the Philippines. It documents the formulation of the Philippine National REDD+ Strategy (PNRPS), including pilot and demonstration projects, and the history and current status of forestry data in the Philippines. In this briefing document we present a detailed review of the lessons learned and experiences gained from the pilot project, especially those that are relevant to the technical aspects of REDD+ implementation.

An overview of the technical aspects and methods of REDD+ implementation is also presented in the main document, while a more detailed description of these tools and methods are included in Annex A. We provide this brief review to highlight the data requirements and to make recommendations on areas of focus for the subsequent forestry data assessment. The two technical aspects of REDD+ that require significant data assessment are: (1) setting up or establishing a reference emission level or reference level (REL/RL); and (2) design or development of a measurement, reporting, and verification (MRV) system. The REL/RL provides baseline information, which serves as the benchmark for subsequent monitoring using the MRV system. REDD+ is conceived as a performance-based incentive system to create opportunities for developing countries to be rewarded, economically or financially, for actions designed to reduce their total emissions, thereby mitigating climate change.

In light of the above, the focus of the data assessment will be in the examination of data needs for generating the activity data and estimating the emission factors. Specifically, the assessment will look into the forest monitoring system, which is needed to generate the activity data, and the forest inventory system, which is necessary for the estimation of the emission factors.

This document also describes forestry data concerns beyond carbon emissions. Specifically, it describes REDD+ co-benefits such as biodiversity conservation and protection, including biodiversity forest monitoring and measurement techniques along with biodiversity data required for REDD+.

[1] REDD+ is Reducing Emissions from Deforestation and Degradation plus fostering conservation, sustainable management of forests, and enhancement of forest carbon stocks.

In response to input from key stakeholders, the document also describes the need for integration of forestry data collected and currently maintained by different agencies, including issues related to storage, archiving, distribution, access, and sharing mechanisms.

Key forestry data issues and concerns within the context of the forestry sector in general, and REDD+ in particular, are described in different sections as follows:

Section 1 provides the background of the AILEG Project in general, and the forestry data assessment and REDD+ task in particular. The section also puts the project within the context of other USAID projects and initiatives, the REDD potential of the Philippines, and the need for a forestry data assessment.

Section 2 provides a brief overview of the REDD+ initiatives in the Philippines, including the formulation of the Philippine National REDD+ Strategy and the National Strategy on Climate Change, and a review of some of the pilot REDD+ projects.

Section 3 describes the history of data collection for, development of, and evolution of forest monitoring and inventory systems in the Philippines, including the tools and methods used in data collection and analysis such as remote sensing and satellite imagery.

Section 4 provides a cursory description of the technical aspects of REDD+, only for the purpose of outlining the requirements of UNFCCC/IPCC so that forestry assessments for REDD+ implementation can be IPCC compliant. Annex A describes in more detail the methods and tools for implementing REDD+.

Section 5 summarizes the nature and types of data needed for each element of REDD+, including those pertaining to the establishment of REL/RL and MRV systems. The methods for REDD+ are described in more detail in Annex A, while the data needs and types of data are described in Annex B.

Section 6 reviews the experiences and lessons learned from implementing the pilot projects. The experience from the GIZ [*Deutsche Gesellschaft für Internationale Zusammenarbeit*/German International Cooperation Agency] pilot project is reviewed in more detail because of its significant contributions in forest monitoring and inventory systems and many of the technical aspects of REDD+.

Section 7 discusses issues pertaining to the adequacy of data and the UNFCCC Conference of Parties' (COP) recommendation to adopt a stepwise implementation of REDD+. This recommendation is primarily due to the limited capability, resources, and data available among developing countries.

Section 8 examines the co-benefits of REDD+. Because global concerns in REDD+ are now extending beyond carbon considerations, other co-benefits such as biodiversity conservation should be considered and actively pursued in REDD+ implementation.

Section 9 provides some information about the landscape approach to implementation of REDD+. This approach emerged from the recent UNFCCC/COP convention as a promising approach and is deemed to be far more effective in reducing GHG emissions because it adopts an integrated, multifunctional strategy that can also accommodate land-use *sharing* among agriculture, forests, and other functions.

Section 10 briefly describes the need for a multi-institutional data infrastructure for forestry data. The section also describes important forward-looking initiatives to provide a forestry data infrastructure that could meet additional future needs, not just for traditional forestry institutions such as the FMB, but also for other governmental and non-governmental organizations (NGOs).

1. BACKGROUND

This briefing document describes the results of the scoping work under the Analysis and Investment for Low-Emission Growth (AILEG) Project, Philippines Activity 2, Energy and Forestry Sector Data Assessments and Economic Analysis, Task 2: Forestry Data and REDD+ Assessment (Forestry Data). The primary goal of this task is "to help the Philippines move towards a more robust forestry data collection system to support GHG inventories and other data needed to advance REDD+ schemes in the country." To achieve this goal, the task has the following objectives: (1) to review the REDD+ program in the Philippines, and (2) to provide an in-depth assessment of the forestry data currently being collected in the Philippines and the identification of data gaps, processes, and tools to manage data. This scoping report accomplishes the first task, providing an in-depth scoping and review of REDD+ in the Philippines.

The Philippines has indicated its desire to participate in the REDD+ program as conceived and proposed by the UNFCCC/COP and IPCC. This expression of interest and willingness to participate are exemplified by the country's participation as one of the United Nations Collaborative Programme on Reducing Emissions from Deforestation (UN-REDD) countries. In fact, even before the Philippines received support under the UN-REDD Programme, the country embarked on the formulation of the Philippine National REDD+ Strategy. This effort is particularly significant because it was spearheaded by civil society and other non-governmental organizations with minimal, if any, funding support from the government and other international donor organizations.

While the Philippines has only about 24 percent forest cover, it is generally considered a good country for REDD+ schemes because of its long history of community-based natural resource management, a capable research community, strong civil society, and recent history of reforestation and forest protection. More recently, the government has embarked on an ambitious multi-sectoral, multi-institutional governmental program called the National Greening Program (NGP). This is a program spearheaded by the President of the Philippines, who signed Executive Order (EO) 26 on February 24, 2011 outlining the vision, goals, and objectives of the program. The NGP hopes to plant some 1.5 billion trees covering about 1.5 million hectares between 2011 and 2016 on lands within the public domain.

In addition, the country promulgated Presidential EO 23 on February 1, 2011, stipulating a moratorium on the cutting of trees, essentially banning logging within the natural forests. This policy, if properly implemented, has significant implications with respect to the potential for protecting the residual natural forests. It also has the potential to bolster efforts to reduce emissions from the cutting of timber within residual forests. Initial indicators of success are mixed in that the policy has resulted in many confiscations of illegally cut logs and arrests of illegal operators, yet newspaper reports have also indicated continued occurrence of illegal logging, particularly in Mindanao.[2]

[2] William B. Depasupil, "Illegal Loggers Laugh All the Way to the Bank," *The Manila Times,* July 10, 2013, http://www.manilatimes.net/illegal-loggers-laugh-all-the-way-to-the-bank/17691/. T. J. Burgonio, "31 DENR Officials in Mindanao Sacked over Illegal Logging," *Philippine Daily Inquirer,* June 30, 2012, http://newsinfo.inquirer.net/221029/31-denr-officials-in-mindanao-sacked-over-illegal-logging. "Anti-Illegal Logging Checkpoints in Northern Mindanao," *Cagayan de Oro Sun.Star,* November 16, 2012, http://www.sunstar.com.ph/cagayan-de-oro/local-news/2012/11/16/anti-illegal-logging-checkpoints-northern-mindanao-253655.

These initiatives, along with a strong forest governance structure established through the long history of community-based forest governance and management, make the country an excellent candidate for REDD+ projects. Enhancement of carbon stocks through afforestation and reforestation is one of the eligible activities in REDD+. Hence, the NGP can potentially be a REDD+ program candidate because of its orientation and focus on "greening" through massive planting.

1.1. COMPLEMENTARY EFFORTS TO REDUCE EMISSIONS IN THE PHILIPPINES

In November 2011, the U.S. Government (USG) and the Philippine Climate Change Commission (CCC) signed a Memorandum of Understanding (MOU) to further cooperate under the Enhancing Capacity for Low Emission Development Strategies (EC-LEDS) program with the goal of supporting LEDS development in the Philippines. Three priority areas of cooperation were outlined in the MOU:

1. GHG Inventories
2. Analytical Tools for Decision Making
3. Measurable Implementation Progress

Subsequently, a workshop on the EC-LEDS partnership was held on January 25-26, 2012, and it included participants from Government of the Republic of the Philippines (GPH) agencies, such as the CCC, National Economic Development Agency, Department of Energy, Department of Transportation and Communications, Forest Management Bureau (FMB) of the Department of Environment and Natural Resources (DENR), and the National Mapping and Resource Information Authority (NAMRIA), as well as several USG agencies, including the U.S. Agency for International Development, State Department, U.S. Department of Agriculture, U.S. Environmental Protection Agency (EPA), and the U.S. Department of Energy. The approved work plan emerging from this workshop has four major pillars:

1. Enhanced Coordination and Support to the LEDS Process
2. Development of the (or Enhancement of the) National GHG Inventory System
3. Analytical Decision Making
4. Measurable Implementation Progress in areas such as renewable energy policy planning; climate-resilient, low-emission land-use planning; national energy policy implementation and monitoring; and a monitoring, reporting, and verification (MRV) system for landscape mitigation actions

One of the components of the EC-LEDS program is the Analysis and Investment for Low-Emission Growth (AILEG) project which was largely conceived to focus on analytical decision making. A primary component of the AILEG program is the provision of data assessment reports for the forestry sector. The forestry data assessment component, in particular, includes conducting a forestry data and REDD+ assessment that is useful to the Government of the Philippines (GPH) and USAID in determining what specific assistance is needed to improve forestry data for REDD+ planning and implementation.

The AILEG Project has coordinated with a number of complementary efforts in the Philippines. These include the Biodiversity and Watersheds Improved for Stronger Economy and Ecosystem Resilience (B+ WISER) Program; the Low-Emission Asia Development (LEAD) Program of USAID's Regional Development Mission for Asia; USAID/EPA Southeast Asia GHG Inventory Partnership Project; DENR/USAID/U.S. Forest Service (USFS) Partnership Project; UN-REDD Programme; GIZ-REDD Project; and REDD+-related projects of other partners including Code-REDD, Conservation

International, and Flora and Fauna International (FFI). Annex C provides brief descriptions of these collaborations.

1.2. FORESTRY DATA ASSESSMENT

The role of the AILEG Project is largely to support the third pillar above – analytical decision making. Based on two trips to the Philippines (April 25–May 4, 2012, and May 22–25, 2012) and consultations with USAID/Philippines staff and the USAID Global Climate Change office, the AILEG team is providing assistance in the following areas:

1. Analysis of the Financial Flows and Barriers for Investment in Clean Energy and Energy Efficiency in the Philippines
2. Energy and Forestry Sector Data Assessments and Economic Analyses
3. Training in LEDS Economic Modeling

The AILEG Forestry Data task is designed to help the Philippines move toward a more robust forestry data collection system that supports GHG inventories and other data needed to advance REDD+ schemes in the Philippines. The task is being implemented in two phases. Phase 1 is generally "scoping" in nature (i.e., a situational analysis that more clearly situates the task in the context of current and future initiatives in the Philippines that share the same goal and objectives, particularly REDD+-related projects). This briefing document summarizes the findings of Phase 1 to ensure that the task is aligned with, and complementary to, ongoing or planned projects of FMB-DENR. In Phase 2, the project will conduct an in-depth forestry data assessment following the general parameters laid out in Phase 1.

1.3. OBJECTIVE OF PHASE 1 TASK

The overall objective of the AILEG Forestry Data task is to conduct a forestry data and REDD+ assessment that is useful to GPH and USAID in determining what specific assistance is needed to improve forestry data for REDD+ planning and implementation and other purposes. During Phase 1, we conducted research and interviews to help focus the actual assessment in Phase 2. The AILEG team completed the following activities:

1. Reviewing the existing and future REDD+ programs in the Philippines.
2. Researching the data currently being collected in the forestry sector in the Philippines (at both the national and provincial levels) to support GHG inventories and the REDD+ program, assessing data quality, identifying data gaps, and making recommendations on data management, particularly with regard to needed data for any future REDD+ schemes in the Philippines.
3. Meeting with Philippine government stakeholders at the national level (e.g., DENR, FMB, NAMRIA, CCC, and universities).
4. Meeting/liaising with other donors in the Philippines working on forestry issues.

The purpose of this briefing document is to outline key forestry data issues and concerns within the context of the forestry sector in general, as well as targeted scoping of REDD+. The concerns identified during the scoping phase are outlined in this document in three parts: Sections 2 and 3 provide a brief review of REDD+ initiatives in the Philippines. Sections 4 to 7 review the technical aspects of REDD implementation as it pertains to data needs and requirements of REDD. Because of the REDD+ orientation of the project, these sections include a description of the tools and methods required for REDD+ implementation. They also contain the data needs and requirements of international bodies such as UNFCCC/IPCC in order that the country's REDD+ submissions in the future conform to, or are consistent with, modalities proposed or recommended by these international bodies. The remaining sections (Sections 8 to 11) focus on data issues and concerns beyond REDD+, including those related to non-carbon emissions, biodiversity, and others focused on future needs of the forestry sector, including institutional arrangements pertaining to data archiving, storage, management, and mechanisms for sharing.

Finally, this document describes initiatives targeted to provide a forestry data infrastructure capable of meeting needs at a later date. These initiatives are designed not solely for traditional forestry institutions such as FMB, but also for government organizations and NGOs.

2. REDD+ INITIATIVES

Formal REDD+ activities started in the Philippines as early as 2009 when the NGO community formed a coalition called CodeREDD and began consultations and advocacy for environment conservation and community development through REDD. CodeREDD led efforts to inform and engage government, civil society, and forest-dependent communities in REDD+ dialogue (USAID/USFS 2011). Eventually, REDD+ emerged from these efforts based on CodeREDD's rich history of partnership involving the public, private, and non-profit sectors in forest management. These efforts were made possible by funding support from a number of donors that were actively engaged in REDD+.

The UN-REDD Philippines National Programme, which began in October 2011, is the result of these efforts. In addition, CodeREDD spearheaded the formulation of the Philippines National REDD+ Strategy (PNRPS), approved by the DENR Executive Committee in August 2010. The UN-REDD National Programme Document was approved in mid-2011, and a Programme inception workshop took place in October 2011. Throughout 2012, the UN-REDD Programme focused on strengthening participatory processes, developing social and environmental safeguards, creating a harmonized methodology for reference baselines, and establishing a national MRV approach.

The PNRPS, the National Framework Strategy on Climate Change (NFSCC), and pilot REDD+ projects in the Philippines are described below.

2.1. THE PHILIPPINE NATIONAL REDD+ STRATEGY

The PNRPS, formulated and led by CodeREDD, is one of the first and most extensive REDD+ efforts in the Philippines. This is in keeping with the readiness phase of REDD+ implementation as recommended and agreed upon by UNFCCC/IPCC (see Section 2.3). The PNRPS is also one of the first REDD+ strategy documents to be completed and nationally approved in Southeast Asia.

The PNRPS vision states: "Empowered forest managers and support groups sustainably and equitably managing forestlands and ancestral domains with enhanced carbon stock and reduced greenhouse gases emission." The expressed objectives of PNRPS include: (1) to prepare forestland managers throughout the country to assume responsibility in implementing the REDD+ program, research, projects, and activities; (2) to support and enhance REDD+ development in the Philippines by guiding REDD+ discussions and activities; (3) to ensure that REDD+ is implemented in a just and equitable manner involving the participation and engagement of forest stakeholders, particularly the forest communities; and (4) to enlighten international donors on the country's plans to implement the REDD+ program.

In 2009, CodeREDD organized and led multi-stakeholder consultations and actively engaged DENR and other government and academic institutions in dialogues and workshops that resulted in the formulation of the comprehensive PNRPS. The PNRPS document provides an overview of the forestry sector in the Philippines, reviews national policies, and specifies strategies and activities to facilitate REDD+ development over a 10-year period (2010–2020). The strategy also recommends a three- to five-year readiness phase and a five-year engagement phase. The document estimated the full strategy's implementation cost at $1 billion over 10 years, which falls within the range of REDD+ implementation estimates reported by other developing nations.

PNRPS presents the strategies in seven overlapping components: (1) Enabling Policy; (2) Governance; (3) Resource Use, Allocation, and Management; (4) Research and Development; (5) MRV; (6) Sustainable Financing; and (7) Capacity Building and Communication. Moreover, the strategy also emphasizes the following key features (USAID/U.S. Forest Service 2011):

- Assumes a nested, scaling up approach to REDD+, with plans to build on existing data sets, capacity, and initiatives, and develop sub-national REDD+ initiatives in priority areas that can be scaled up in 3-5 years.
- Targets projects on sites where emissions reductions can be achieved at a reasonable scale and cost, while seeking to maximize co-benefits (rural development, carbon sequestration, and biodiversity conservation). Focus is on sub-national projects in priority areas where tenure is established.
- Recognizes the need for national level REDD+ oversight and management, but prioritizes the decentralization of natural resource management.
- Seeks to strengthen and align existing structures, and streamline project development, rather than unnecessarily introduce new bodies and regulations.
- Seeks to deliver multiple social benefits: sustainable rural development, promoting community based management and monitoring activities, and emphasizing equitable benefit sharing. Prioritizes community rights to determine how and whether they engage with REDD+.
- Seeks to utilize participatory planning, multi-stakeholder and multilevel approaches for planning and implementation.
- Assumes an inter-sectoral approach—views REDD+ as a catalyst for significant, necessary reforms.

2.2. NATIONAL FRAMEWORK STRATEGY ON CLIMATE CHANGE

The Climate Change Act was promulgated in October 2009, leading to the creation of a Climate Change Commission (CCC), a governmental institution that now serves as the national-level decision-making body on climate change adaptation and mitigation. The Commission spearheaded the formulation of the NFSCC, which includes REDD+ and a National REDD+ Strategy as an integral part. On April 26, 2011, Executive Order 881 authorized the CCC to coordinate existing climate change initiatives, including those related to REDD+. It further designated DENR as the operational arm for REDD+ activities and manager of resources related to REDD+ acquired by the government. EO 881 also provided the initial framework for REDD+ decision making and operationalization. Specific provisions of the Executive order mandated the CCC to serve as the coordinating unit and authorized the unit "to include in the scope of its coordination the programs and action plans relating to Reducing Emissions from Deforestation and Forest Degradation – Plus (REDD+), and other similar mechanisms. The Department of Environment and Natural Resources (DENR) shall serve as the operational implementer of REDD+." With these developments, REDD+ in the Philippines had not only a strategy for implementation, but also the legislative support and leverage to constitute itself as one of the more important government programs. The NFSCC's REDD+ priorities include formulating policies to enhance the forestry sector's ability to reduce emissions; strengthening REDD+ governance mechanisms; promoting a watershed approach toward REDD+ planning; establishing broad science-based REDD+ research and development; establishing and implementing a subnational REDD+ MRV system; formulating and implementing a national REDD+ communication plan; and exploring and capitalizing on opportunities for financing REDD+ (see Annex D).

2.3. PILOT REDD+ PROJECTS IN THE PHILIPPINES

To ensure reliable and credible implementation of REDD+ projects, UNFCCC/IPCC recommends a three-phase implementation approach:

- Phase 1: Readiness (development of national strategies and design of action plans, policies and measures, organization of the REDD+ process, and initial capacity building),
- Phase 2: Implementation of REDD+ strategy (policies, measures and action plans), and
- Phase 3: Implementation of performance-based actions through e.g., payment schemes for verified emissions reductions and removals.

Under Phase 1, pilot projects are recommended for developing countries to gain some experience and learn important lessons, including collection of preliminary data for REDD+ implementation. Table 1 shows a summary of the pilot REDD+ projects in the Philippines.

In addition to the Philippine National REDD+ Strategy, REDD+ initiatives in the Philippines include various pilot or demonstration projects situated in different regions of the country. These pilot projects are in keeping with the UNFCCC/IPCC recommendation for developing countries to pursue these projects as "learning" modules, thus gaining valuable experience and data needed for the implementation of REDD+ activities, including the setting of reference emission levels (RELs) and setting up MRV systems. Support for demonstration projects was provided by international donors including the United Nations [Food and Agriculture Organization (FAO), United Nations Development Programme (UNDP), United Nations Environment Programme (UNEP)], *Deutsche Gesellschaft für Internationale Zusammenarbeit*/German International Cooperation Agency (GIZ), the Swiss Government, the Asian Development Bank (ADB), Flora and Fauna International (FFI), and some private multinational companies. Table 1 summarizes these pilot projects; the GIZ pilot project is described in more detail in Section 6.

TABLE 1. PILOT REDD+ PROJECTS

Proponents	Where	Area	Funding Source	Strategy
FFI/Non-Timber Forest Products (NTFP), Indigenous Peoples (IPs), People's Organizations (POs), local NGOs	Quezon Province, Southern Sierra Madre	180,000 ha	Swiss Government	In process
FFI/NTFP, provincial local government units (LGUs), IPs	Palawan Province, Victoria-Anepahan Mountains	50,000 ha	Swiss Government	In process
Kalahan Education Foundation	Nueva Vizcaya Province, Ikalahan ancestral forests		Mitsubishi	In process
Conservation International, LGUs, POs	Quirino Province	177 ha	MoreTrees, Inc. (from Japan)	Afforestation, Certified CCBA
Conservation International, LGUs, POs	Cabayan Province, Penablanca Sustainable Reforestation Project	2,943 ha	Toyota	Afforestation, Certified CCBA
GIZ, LGUs	Southern Leyte	5 municipalities	German Government	Reduced deforestation & degradation; reforestation

Source: USAID/U.S. Forest Service (2011).
Note: CCBA = Climate, Community & Biodiversity Alliance.

3. FORESTRY DATA IN THE PHILIPPINES[3]

The first nationwide forest inventory in the Philippines was carried out from 1965 to 1969. This inventory made use of aerial photographs with an average scale of 1:12,000, enabling detailed mapping of the different forest categories and further segregation into several levels. The forest inventory used photo-point sampling on aerial photographs combined with ground plot sampling. Ground plot samples were systematically selected from the aerial photos using forest photo points identified using systematic sampling where the distance between sampling plots is set *a priori* so that the required number of ground samples to meet a specified accuracy is met.

In late 1977, the Natural Resource Management Centre introduced satellite imagery (Landsat) as an additional source of data for conducting forest inventory and mapping. This mapping activity was conducted in cooperation with the General Electric Company of the United States. Thirty Landsat images taken between 1972 and 1976 were digitally processed and used as the basis for identifying the geographical distribution of the different forest types in the country. This initiative, however, did not receive the "official" status of a nationwide forest inventory, even though the results appeared to be consistent with the unofficial trends indicated in the 1965–1969 national forest inventory.

The second nationwide forest resource inventory was conducted between 1979 and 1988. With the assistance of FAO, the forests of Regions 10 and 11 were inventoried between 1979 and 1983. Then, in 1983, the Republic of the Philippines (RP)-German Forest Resource Inventory (FRI) Project began. For this inventory, a two-stage inventory design was adopted using aerial photographs or satellite imagery. In the first stage, all natural forest areas in the Philippines were mapped using aerial photographs. For areas or regions where no aerial photographs were available, Landsat or SPOT satellite images were used for forest mapping and area calculation. For the second stage, all economically significant forest types, primarily *Dipterocarp* and pine forests, were sampled in the field using a stratified, restricted sampling design. All regions, except Regions 10 and 11, were inventoried from 1984 to 1988 using this methodology (i.e., 75 percent of the total forest resources).

For the 1979–1988 inventory, field sampling expanded the scope of the earlier 1965–1969 inventory to include "ground truthing" of all tree regeneration, rattan, bamboo, and erect palms. This was done to determine on a regional basis the following: (1) an estimation of the future timber supply, (2) an estimation of available minor forest resources, and (3) the suitability of Dipterocarp forest stands for timber stand improvement treatments. The FRI project adopted most of the basic forest types used in the first inventory.

Data collection commenced in November 2002 and terminated in July 2004. The Regional Field Inventory Teams submitted field reports covering 367 tracts to FMB. Of these, six tracts had totally fallen into the sea (non-inland water) and four tracts had partially fallen into the sea.

[3] This review draws heavily from Acosta (2005).

The inventory component of the FAO-supported FRA Project (2005 established sample plots not only in the legally classified forestland but also on alienable and disposable (A&D) lands and on private lands. Further, data collection went beyond the traditional measurement of the biophysical characteristics of the trees to also document the stock and flow of wood and non-wood forest products and services. Another significant milestone of the FRA Project was the inclusion of the social, economic, and ecological attributes of the forest among its variables. Data such as ownership, use and users, and management of forest resources were generated. These were not considered in the earlier national forest inventories. These data were gathered through interviews of local forest users who extract forest products from the sites measured and also gathered from selected key informants who have information about the forest products extracted. The biophysical variables, on the other hand, were gathered through actual measurement and direct observation.

Forest data reported in the assessments may reflect some differences, particularly in the estimates of forest cover. It should be pointed out that forest definitions used in these assessments also varied, which can account for the differences in the estimates of forest cover.

4. TECHNICAL ASPECTS OF REDD+ IMPLEMENTATION

This section provides a brief description of the technical aspects of REDD+ in order to outline the requirements of UNFCCC/IPCC so that forestry assessments for REDD+ implementation can be IPCC compliant. Annex A describes in more detail the methodological tools for implementing REDD+.

4.1. SETTING REFERENCE EMISSION LEVELS/REFERENCE LEVELS

RELs/RLs are a significant component in the design and implementation of REDD+ mechanisms. Reference levels serve as a baseline for estimating reductions in emissions. They depict business-as-usual emissions; that is, expected emissions if no mitigation options are implemented. Hence, RELs provide some benchmark for determining or estimating reductions in emissions resulting from REDD+ intervention. RELs are important as a basis for determining eligibility for bilateral or international results-based or performance-based support, as a benchmark for evaluating the impacts of REDD+ activities, and for calculation of the amount of support on the basis of verified emissions.

RELs/RLs can be set based on historic emissions, often primarily due to deforestation. Estimating historic emissions involves estimation of two components: activity data and emission factors. These are described in more detail in Annex A.3.

4.2. MEASUREMENT, REPORTING, AND VERIFICATION

While setting reliable reference scenarios is important, equally important is the design of an effective MRV system. Official guidelines for REDD+ MRV are yet to be finalized. In the meantime, the IPCC 2003 Good Practice Guidance for Land Use, Land Use Change and Forestry (GPG-LULUCF) and the IPCC 2006 Guidelines for National Greenhouse Gas Inventories for Agriculture, Forestry, and Other Land Uses (GL-AFOLU) provide broad descriptions of significant first steps that can serve as general guides for designing MRV systems. However, these steps need further refinement and elaboration, particularly on specific methods to estimate emissions from deforestation. The MRV system is at the core of REDD+ because it provides a means of integrating the different components of REDD+. It provides the system by which changes in land use/cover can be measured and monitored. It also offers the opportunity to evaluate the country's REDD+ program's effectiveness, not only for monitoring emissions and removals, but also for the other benefits and concerns of REDD+. The content of an MRV system to monitor changes in forest area is described in Annex E.

4.3. MRV SYSTEM FOR MONITORING CHANGES IN FOREST AREA

An MRV system's technical methods for the design and measurement of forest inventory systems may include the establishment of classic field inventory sampling plots; use of remote sensing and imagery including the use of satellites, radar, aerial photos, and other sources of data; and geo-spatial technologies including GIS and remote sensing. Key references here are IPCC (2003, 2006), and the GOFC-GOLD Sourcebook (2010).

The Sourcebook contains technical descriptions of the following: (1) monitoring of changes in forest areas, (2) estimation of aboveground carbon stocks, (3) methods for estimating CO_2 emissions from deforestation and forest degradation, (4) methods for estimating GHGs from biomass burning, and (5) estimation of uncertainties. More detailed descriptions of these five topics are provided in IPCC (2006). Some of the topics are also described in other sections of this paper: Annex A.2.3 provides some description of the tools for estimating carbon stocks, while Annex B.2.2 describes the process of stratification for more accurate estimation of emission factors.

5. DATA NEEDS AND FOCUS OF FORESTRY DATA ASSESSMENT

This section summarizes the nature and types of data needed for REDD+. Setting up REDD+ projects requires initial decisions to determine the project scope, and subsequent datasets. These decisions, which will help define the two important technical aspects of REDD+ (RELs/RLs and MRV systems) include (1) Forest Definition; (2) Scope of Activities; (3) Period of Analysis; and (4) Scope of Implementation. The methodology for REDD+ is further defined in Annex A, while the data needs and types of data are described in Annex B.

As described in Section 3, the Philippines has performed forest cover mapping and assessed forest inventory intermittently over the last few decades. Many of the more recent data collected and maintained by the Philippines (which are national in scope) are based on the data collected in the 2005 Forest Resources Assessment. The FRA Project in the Philippines was initiated in August 2002 for the assessment of Philippine forest and tree resources as part of the framework of the Forest Resources Assessment Programme of the FAO (FAO 2005).

Previous to the 2005 FRA, the last national forest cover mapping and timber inventory assessment was conducted through the RP-German Forest Resource Inventory project. NAMRIA is currently in the process of completing the 2010 national forest cover and land use cover mapping. A previous national forest inventory was completed in 1965-1969.

As indicated above, the two comprehensive national forest mapping and inventories were conducted in 1988 through the RP-German national FRI project, and the 2003 FRA project. National reports submitted in other years (e.g., 1990, 1995, 2000) submitted to FAO for the Global Resource Assessments were based on interpolations between the national data collected in the RP-German project in 1988 and the FRA data collected in 2003. Similarly, estimates for the national forest cover and inventory for 2005 and 2010 were based on simple extrapolations from the 1988 and 2003 collected national data. Sources of forestry statistics and inventories are described in Annex E.

5.1. NEED FOR FORESTRY DATA TO BE IPCC-COMPLIANT

To prepare the Philippines to participate and compete for funds in the global REDD+ programs under UNFCCC/IPCC, its forestry data must be better organized, more reliable, more accurate, and more transparent in terms of collection and accessibility. In other words, the Philippines' data collection system, forest inventory, and monitoring systems should be made more robust and compliant with UNFCCC/IPCC.

To date, it appears that the current forestry data may be adequate but are loosely organized, ad hoc in their organization and management, and in need of refinements to meet standards or modalities mandated by UNFCCC/IPCC. For instance, Activity Data, in terms of forest cover change within specific periods, and Emission Factors (carbon content of relevant carbon pools such as above ground and below ground biomass, soil carbon, litter, and wood debris) required in estimating carbon emissions are still lacking. However, the stepwise approach to REDD+ implementation (see Section 7) does not preclude the Philippines from participating in REDD+ programs despite these data inadequacies. The Philippines must start with its current data infrastructure but put itself on a path toward generating improved datasets in the future.

The Philippines' current forest monitoring, particularly its capacity to generate accurate activity data described in Annex A.3, needs improvement. Data needed for measuring and monitoring deforestation are not currently in place. Key government agencies appear to have the capacities for the data generation, processing, and analysis needed to generate activity data.

The forest inventory systems of the Philippines need improvement to enable generation of the emission factor necessary to calculate carbon emissions above ground. Allometric equations (models that estimate the above ground biomass of trees based on diameter, height, and wood density) that enable the estimation of aboveground biomass are not currently adequate and still need to be developed for key species and species groups.

5.2. FOREST MONITORING AND SPATIAL DATA

Activity data assessment at the forest level will require collection and analysis of spatial data on a large scale. Consequently, technologies such as remote sensing and geographic information systems (GIS) are prerequisites for most commonly used tools to monitor land use or forest cover changes over time. Hence, for REDD+ implementation, UNFCCC/IPCC also recommends the use of these technologies for more reliable data collection and analysis. Ground-based inventories will still be necessary for "ground truthing" of data collected from remote sensing.

The Subsidiary Body for Scientific and Technological Advice (SBSTA), a commissioned body organized under UNFCCC/IPCC, has developed and recommended methods and tools for monitoring using remote sensing, GIS, and ground-based field measurements. These methods and tools are described in two major documents, the Global Observation of Forest Cover and Land Dynamics (GOFC-GOLD) Sourcebook (2012) and the IPCC Guidelines (2003, 2006). Table 2 shows the sources of remote sensing data with different resolutions commonly used for forestry assessment and monitoring.

TABLE 2. UTILITY OF OPTICAL SENSORS AT MULTIPLE RESOLUTIONS FOR DEFORESTATION MONITORING

Sensor & Resolution	Examples of Current Sensors	Minimum Mapping Unit (Change)	Cost	Utility for Monitoring
Coarse (250-1000 m)	SPOT-VGT (1998-) Terra-MODIS (2000-) Envisat-MERIS (2004-)	~ 100 ha ~ 10-20 ha	Low or free	Consistent pan-tropical annual monitoring to identify large clearings and locate "hotspots" for further analysis with mid resolution
Medium (10-60 m)	Landsat TM or ETM+, Terra-ASTER IRS AWiFs or LISS III CBERS HRCCD DMC SPOT HRV	0.5 – 5 ha	Landsat & CBERS are free; for others: <$0.001/km² for historical data $0.02/km² to $0.5/km² for recent data	Primary tool to map deforestation and estimate area change
Fine (<5 m)	IKONOS QuickBird Aerial photos	< 0.1 ha	High to very high $2 - 30/km²	Validation of results from coarser resolution analysis, and training of algorithms

Source: GOFC-GOLD (2012).

5.3. METHODS FOR ASSESSING FORESTRY DATA NEEDS AND REDD+

To ensure that forestry data needs are adequately and comprehensively examined, the AILEG team conducted an extensive consultation involving stakeholders and key actors in REDD+ and forestry data and information systems. We consulted selected representatives of different organizations and partners, including the UN-REDD Philippines National Programme, GIZ, Conservation International, Flora and Fauna International, CodeREDD, the Non-Timber Forest Products – Exchange Program, and the Climate Change Commission. In addition, we consulted the FMB leadership team, NAMRIA leadership team, and the Biodiversity Division of DENR's Protected Areas and Wildlife Bureau. In these consultations, the AILEG Forestry Data task's goals and scope, and its focus on REDD+ data needs, were discussed. These consultations helped identify the areas and aspects of forestry data that are most needed in terms of addressing REDD+ concerns, particularly those pertaining to carbon emissions and other elements of a GHG inventory.

5.4. FOCUS OF THE FORESTRY DATA SCOPING TASK

The two primary components of REDD+ implementation are forest monitoring and forest inventory systems. The forest data assessment should evaluate the status and needs of these two systems, as described below.

5.4.1. FOREST MONITORING SYSTEM

Forest monitoring is essential for REDD+ because it generates the activity data for calculating the total amount of carbon emission releases or removals. Assessment of forestry data relative to forest monitoring should focus on:

Forest Cover Map: For the purpose of REDD+, a benchmark map is needed. The estimate of emissions and removals from deforestation, forestation, and other eligible REDD+ activities in forest areas requires an initial forest condition (or reference map) against which future emissions and removals can be compared. Having an initial benchmark (or baseline) forest map can help determine where monitoring should be done to evaluate loss in forest cover (GOFC-GOLD 2010). Moreover, having a benchmark forest map makes forest monitoring for deforestation easier by enabling comparison of current forest cover with the benchmark forest map.

A forest cover map should be generated for at least two time periods. It appears that 2003 and 2010 maps are available and should be examined closely to determine their efficacy for forest monitoring. The advantage of the 2003 FRA is that it has been applied nationwide and has been the source of data on forest cover and other land use/cover. The forest cover map of 2010 may be appropriate to serve as the benchmark map. Also, the timber inventory data obtained from the 2003 FRA can constitute part of the historical emission data. The forest cover maps from these two periods should enable the setting of national RELs/RLs. Ideally, wall-to-wall maps should be created if data are available. If not, hotspots (e.g., areas likely to be deforested or degraded) should be identified and mapped so they can be monitored. Plantations and reforestation areas should be high-priority areas to identify and map because FMB leadership has expressed great desire to assess and map these areas.

Land Use/Cover Map: To more completely account for total carbon emissions/removals, a more comprehensive land cover map should be created. Creating land cover maps and benchmark maps from the different data types and using the image processing, image classification, and interpretation methods will enable the generation of land cover change maps, a prerequisite for activity data estimation. It is advisable and recommended by this report that if data are available, land cover maps show at least three points in time. Change detection will be based on these three land cover maps.

The GIZ pilot project described in Section 2.3 and presented in more detail in Section 6 is a good example and model that can be adopted in setting up a forest monitoring system. The schematic diagram shown in Annex F (Mesa Consult 2011) is a good model to use in examining the dataset needed to establish RELs/RLs, and also in terms of the tools described for monitoring forest cover changes through time.

The 2003 FRA should also be examined to determine its efficacy for forest monitoring. The advantage of this system is that it has been applied nationwide and has been the source of data on forest cover and other land use/cover.

Plantation and reforestation areas should be high-priority areas to identify and map because FMB leadership has expressed the desire to assess and map these areas.

5.4.2. FOREST INVENTORY SYSTEMS

Forest inventory systems primarily involve field-based measurements, which are needed to estimate carbon content or emission factors. These are combined with the activity data to calculate total carbon emissions or removals. Very likely, the carbon pool that has to be measured and reported for REDD+

project submissions is the aboveground biomass (AGB). This is because AGB is perhaps the most significant carbon pool in terms of magnitude and therefore should be measured and monitored.

To assess AGB, field measurements are necessary. In other words, tree-based characteristics such as height, diameter, and crown canopy must be determined. Allometric equations have to be developed to transform these tree-based measurements to AGB equivalents. Allometric models (Chave et al. 2005) are now available to use for developing allometric equations for different species and species groups.

Allometric equations will take time to develop. In the meantime, data should be reviewed and assessed for stand tables, stock tables, and volume tables for many commercial species in the Philippines. Annex B.2.3 describes some of these datasets and how they can be adapted for the measurement of AGB.

Plantations and reforestation areas are also quite widely distributed in the Philippines. Hence, forestry data review should also focus on AGB for common plantation and reforestation species.

Other carbon pools, such as soil carbon, deadwood, litter, and belowground biomass, may also be included as part of REDD+ submission in the future. The availability of data on these carbon pools should also be assessed. Because belowground biomass is difficult, laborious, and very costly to measure, UNFCCC/IPCC recommends estimating it as a function of AGB.

5.4.3. BIODIVERSITY MONITORING AND INVENTORY SYSTEMS

In the Philippines, systems for monitoring and measuring biodiversity are still in their infancy. For REDD+ purposes, the FFI pilot projects at the Southern Sierra Madre and Southern Palawan REDD+ sites offer the first comprehensive demonstration projects that have been designed for REDD+ biodiversity concerns. The pilot projects have developed and applied some biodiversity measurement schemes, sampling designs, and inventory systems that should be examined for possible adoption.

6. EXPERIENCE FROM PILOT PROJECT IMPLEMENTATION

The pilot projects described in Section 2.3 have yielded important lessons in REDD+ implementation. The GIZ project in particular is significant for forest monitoring (i.e., generating activity data) and forest inventory systems (i.e., generating carbon emission factors). The project has generated important data that can be adopted as a "model" for REDD+ projects. The GIZ project, described here, covers and encompasses many of the technical and non-technical phases and components of REDD+ implementation.

Mesa Consult (2011) describes some of the operational and technical tools for forest monitoring used in the REDD+ pilot project. The report also discusses data needs, sampling designs, allometric equations, and tools for stratification. Furthermore, the report includes information and general guides on the process of generating activity data to estimate emissions from deforestation and forest degradation. Specifically, the report describes guidelines on how to monitor deforestation using different data types, including radar and land satellite data.

Mesa Consult (2011) took an in-depth look at REDD+ implementation in the Philippines using the pilot project in southern Leyte as a reference point. The study set out to look at forest carbon monitoring systems to assess and monitor the GIZ project in the province relative to GHG mitigation and carbon emission and sequestration from REDD+ activities and other co-benefits such as biodiversity conservation. The proposal resulting from the study was for a comprehensive MRV system that fulfills the requirements of UNFCCC/IPCC. The proposal, which is still being evaluated, was for a three-phase approach to monitoring deforestation as follows: Phase 1 makes use of remotely sensed data of medium resolution in wall-to-wall mapping (2000–2007); Phase 2 also makes use of medium-resolution data for wall-to-wall mapping combined with statistical accounting of land use changes (2007–2012); Phase 3 makes use of high-resolution data for wall-to-wall mapping (2013 onward). The process map for the Mesa Consult project (see Annex I) outlines the three phases and the types of data that can be used for each phase, which are described in the following paragraphs. As shown in Annex I, the accuracy and resolution of the datasets increase from phase to phase.

In Phase 1, Landsat 7 ETM data at 30m spatial resolution were used. The report noted the pervasive problem of cloud cover and stated that, even under favorable conditions of the high temporal frequency of the Landsat 7 ETM coverage combined with Landsat 5 Thematic Mapper data, cloud cover still is a problem at both the subnational and national scale. The pilot study recommended that optical data used should be complemented with a coarser (but still medium-resolution) radar dataset. Inevitably, resampling of some datasets is needed to make the data consistent. Radarsat-1 is recommended as a potential sensor data source to "close" cloud-cover gaps (i.e., this source will be used for those areas in Landsat data covered by cloud cover).

Phase 2 combines both remotely sensed data and some statistical methods of analyzing land use data. While the Phase 1 processing described above also adopts a hybrid approach combining different data sources, what was adopted in Phase 2 (2007–2012) can improve accuracy for the next phase by processing homogenous radar datasets using the freely available 50m orthorectified (i.e., geometrically corrected by removing the effects of tilt relief or terrain) Advanced Land Observation Satellite (ALOS) PALSAR data for the periods 2007–2010 and 2010–2012 (Mesa Consult 2011, p. 10).

Phase 3 is proposed to use high-resolution wall-to-wall deforestation and land use change mapping. This proposal is made with the expectation that some new satellites (e.g., Landsat 8) and ALOS-2 will offer high-resolution remotely sensed spatial data.

This three-phase approach is consistent with the stepwise implementation of REDD+ among developing countries as described in Section 7.

7. ADEQUACY OF DATA AND STEPWISE IMPLEMENTATION OF REDD+

It is well recognized at the international level that the ability of developing countries to establish and implement REDD+ hinges on the availability of reliable and high-quality data that are sufficiently comprehensive in scope and over time. For instance, it has been recommended that developing countries should start setting RELs/RLs by developing scientifically credible estimates of their historic emissions and removals based on data collected according to accepted standards. Herold et al. (2012) concluded that a stepwise approach to developing RLs can reflect different country circumstances and capacities and will facilitate broad participation, early startup, and the motivation for improvements over time, alongside efforts to enhance measurement and monitoring capacities.

As indicated in the previous sections, two elements are needed to set RELs/RLs. These are the activity data and the emission factors. Both require reliable data to enable accurate estimation. In light of the lack of reliable (i.e., accurate and complete) data, it is recommended that a stepwise or tiered approach be adopted for both activity data estimation and the emission factor calculation. In the case of activity data, most developing countries, like the Philippines, are most likely to start with Approach 1 as described in Annex A, where only net changes are estimated from national data typically reported from national statistics. Subsequently, it is also recommended that most developing countries, including the Philippines, set themselves on a path that results in improvement of their data collection, and thus ultimately adopt Approach 2. This will require more specific tracking of land use/cover changes among land categories. However, it is not necessary for data to be spatial (i.e., activity data do not need to be location specific). Again, Approach 2 will require more data in terms of estimating the area of various land use/cover categories through the implementation period. Finally, as countries become more familiar with the data demands of activity data estimation, and as more capacity in terms of human and technological resources becomes available, countries can adopt Approach 3, which is essentially an extension of Approach 2 that makes the data spatially explicit or location specific. In other words, estimation of activity data is not only in a tabular database, but also in spatial databases that could be mapped or made spatially explicit.

Similarly, countries will have to adopt a stepwise approach in the estimation of emission factors for different types of forests. Initially, countries can adopt Tier 1 as shown in Annex A. Here, no data are required; hence countries only need to obtain emission factor estimates from IPCC's Emission Factor Database. As countries establish inventory sample plots and conduct emission factor studies that are designed to estimate emission factors for different types of forests, they can advance to the use of Tier 2. Finally, with more detailed studies, countries should strive to generate estimates for the emission factors of different carbon pools. Once these are available, a more accurate estimate of emission factors can be determined, and therefore more accurate accounting of carbon emissions/removals can be achieved.

8. CO-BENEFITS OF REDD+

The objectives of the forestry data assessment go beyond the technical aspects of REDD+. Increasingly, global concerns in REDD+ are now extending beyond just carbon considerations. Instead, other co-benefits such as biodiversity conservation should now be considered and be actively pursued in REDD+ implementation. Moreover, REDD+ should be more broadly viewed from a landscape perspective, not just from the perspective of forested areas. The results of the latest UNFCCC/IPCC convention at Doha, Qatar, affirm what has recently been a growing sentiment to make REDD+ more inclusive and extend its scope beyond the forestry sector. Hence, concerns such as agroforestry and food security should be embraced under a more encompassing landscape approach to REDD+ implementation. The sections that follow describe some of these concerns beyond the carbon-based aspects of REDD+.

The original language about co-benefits in the context of REDD+ came from the UNFCCC/COP-13 Bali Action Plan, which stated that REDD can promote co-benefits and thus may complement the carbon emission benefit of REDD+. Subsequently, a number of parties have also requested in their submissions to the UN-REDD Programme Secretariat that REDD co-benefits be taken into account. Moreover, many developing countries, on the recommendation of the subsequent COP decision, now have the option to consider multiple benefits in national and subnational implementation of REDD+.

A number of authors (Miles et al. 2009) have reported that beyond their contribution to climate change mitigation, other co-benefits offer significant added value and economic incentives. Examples of these include biodiversity conservation and development. In fact, at the 16th UNFCCC Conference of the Parties (COP-16), countries agreed to an initial framework for REDD+ action established by the Cancún Agreements (FCCC/CP/2010/7/Add.1) that includes specific guidance such as: (1) taking into account the multiple functions of forests and other ecosystems; (2) implementation in the context of sustainable development and reducing poverty; and (3) consistency with adaptation needs of the country. Internationally, countries have recognized that REDD+ provides non-carbon benefits, called co-benefits, such as biodiversity conservation, adaptation, ecosystem services, livelihoods for local communities, and broader economic benefits. Hence, in addition to the mitigation potential of REDD+, the co-benefits are considered significant positive impacts that must also be highlighted in REDD+ implementation (Lee et al. 2011).

At the most recent UNFCCC/IPCC convention at Doha, Qatar (December 2012), biodiversity conservation emerged as a major co-benefit that must be considered in REDD+ implementation (Parrotta et al. 2012). This comprehensive report examined the complex relationships among biodiversity, carbon, forests, and people. The report stated:

> A number of actions, including changes in land use and management practices (in both forested and non-forested land) can achieve REDD+ objectives while also conserving biodiversity and enhancing the provision of other forest ecosystem services. Selecting the most appropriate approaches for implementing such actions is critical to ensuring the best outcomes for biodiversity, carbon, and other ecosystem service benefits, and for people. Importantly, given the complexities of forest ecosystems and their management, and their importance for biodiversity and human well-being, poorly designed and implemented REDD+ interventions could have serious adverse impacts on biodiversity and people.

9. LANDSCAPE APPROACH TO IMPLEMENTATION OF REDD+

At the most recent UNFCCC/COP convention at Doha, Qatar, December 2012, the parties called for a broader, more encompassing, and multi-functional approach to REDD+. Such an approach is deemed far more effective in reducing GHG emissions because it adopts an integrated, inclusive strategy that can also accommodate land-use *sharing* in agriculture, forests, and other functions. This is more commonly referred to as a landscape approach, which also considers other ecosystem services that the forests can provide. In addition to their role in the carbon cycle, forests are important for other element cycles, such as nitrogen and phosphorus, by storing, modifying, and transporting these substances through landscapes. Forests are a great sanctuary for wildlife and repository for water, and serve as habitat for diverse flora and fauna.

The landscape approach departs from the classic agriculture versus forestry dichotomy, which historically has resulted in addressing issues independently rather than holistically. A broad-based landscape approach can also accommodate other natural resource concerns such as water availability along with other co-benefits such as biodiversity conservation as described in Section 8 above.

The landscape approach is receiving more widespread support among developed and developing countries, including donor agencies. Along with the expanded view of REDD+ beyond the forest boundaries, there is increased concern beyond GHG inventories, with the more encompassing goal of environmental sustainability. Achieving such a goal, which can be perceived as complementary to and in tandem with the objectives of REDD+, the landscape approach considers the design and implementation of REDD+ projects requiring understanding of the local ecological, economic, and social contexts. Hence, REDD+ programs should be designed in the context of their impacts not only on carbon emissions/removals, but also on the ecosystem, from both a conceptual and an ecosystem-scale perspective.

Many policies related to REDD+ have focused on the drivers of deforestation. There has been little focus on the drivers of forest degradation, and especially the drivers of REDD activities, specifically conservation of carbon, sustainable forest management, and carbon enhancement (the + part of REDD). The landscape approach will frame the REDD+ implementation within the wider scope of payments for ecosystem services.

The landscape approach also provides a broader scope within which to develop and organize the forestry sector data. This approach provides a platform for the forestry sector to interface with non-forestry sectors such as the agricultural sector, and to coordinate activities related to both REDD+ in particular, and climate change mitigation and adaptation in general. In other words, a more comprehensive assessment of carbon emissions (and other GHGs such as methane) can be made throughout the landscape. Along with the GHG assessment, the landscape approach allows the forestry sector to more completely monitor land use changes and forest cover changes, extending the monitoring area beyond the traditional forested landscape to include the agricultural and other lower-elevation vegetation. Much of the forest cover changes monitored in REDD+ are those related to deforestation, most commonly due to conversion of forestland for agricultural purposes. Previous studies (Lasco 2001; Union of Concerned Scientists 2011) have shown that conversion to agriculture (shifting cultivation) has been one of the major causes of deforestation in the Philippines because this practice often involves cutting trees and clearing forest areas for subsequent planting of agricultural crops. However, this claim is controversial as other experts identify large-scale logging and other development as having a greater impact on deforestation. The practice of shifting cultivation called "slash and burn" or *kaingin* in Tagalog, often follows after logging or timber harvesting operations where openings to the forests are created, making it easier to clear forest areas and convert them to agricultural croplands. Mining has not recently been, and is not likely to be, a significant driver of deforestation in the near future because of current negative perceptions about the impacts of mining. Less attention has been given to monitoring conversion of forests to other uses (e.g., pasturelands, urban or residential developments). A landscape approach could provide a broader platform for the forestry sector to organize and plan for its data needs and infrastructure.

10. INSTITUTIONAL AND PROGRAMMATIC CONCERNS ABOUT FORESTRY DATA

Forestry data have many uses beyond the forestry sector itself. Other agencies and organizations make use of forestry-related data for different purposes such as planning, strategy development, economic development, and other management concerns. This section describes the need for a multi-institutional data infrastructure for forestry data.

Different agencies and organizations—depending on their needs—collect, store, and manage different data, including forestry-related data. Many of these data are internally managed and stored with restricted database structures or formats, thereby limiting their use and distribution. Often, these data are only for the internal use of the organization, with little or no concern given to the possibility of sharing the data or making them available to other potential users.

During extensive consultations with EC-LEDS partners and other agencies, organizations, and stakeholders in the forestry sector, there was almost unanimous expression of the glaring need for a mechanism for data sharing. Many agencies collect different forestry-related data and maintain these data for their use. Such data may be useful to other potential users. There is therefore a need to create a data infrastructure where data from different sources (e.g., managed and maintained by other agencies) can be integrated and stored in a format that allows for convenient data access and data sharing. In other words, there is a need to create a data clearinghouse.

A clearinghouse is a distributed, electronically connected network of geospatial data sources, producers, managers, and users. It is neither a central repository where datasets are stored nor a set of websites referencing spatial data. It is a federated system of compatible geospatial data catalogs that can be searched through a common interface. Hence, a clearinghouse is essentially a metadata collection made searchable through common protocols. Each data producer or maintainer describes available data in electronic form and prepares these descriptions (the metadata) for clearinghouse access using a variety of free and commercially supported software.

Constructing a clearinghouse requires the design of a spatial data infrastructure, a data infrastructure implementing a framework of geographic data, metadata, users, and tools that are interactively connected in order to use spatial data in an efficient and flexible way.

NAMRIA is currently developing a geoportal for spatial data that shares the same vision and goal as a clearinghouse with a broad spatial data infrastructure. Other forestry-related agencies should support this effort so that the geoportal can be established with the range of datasets, protocols, and functionalities that will allow it to serve different agencies.

11. CONCLUDING REMARKS AND RECOMMENDATIONS

This scoping and review document was written as a guide for subsequent forestry data assessment in the Philippines focusing on issues related to the technical requirements of REDD+, along with other concerns of the forestry sector beyond REDD+. Hence, it is instructive to provide some concluding remarks that will serve as guiding principles and recommendations for the subsequent forestry data assessment.

It is strongly recommended that the two most important types of forestry data needed for REDD+ should be the primary focus of the assessment. These are the forest monitoring system and forest inventory system. The forest monitoring system is important because it provides the mechanism for the generation of Activity Data needed information for assessing the change in land cover or forest cover (e.g., deforestation, forest degradation) needed to estimate emission levels, including RELs/RLs. The forest inventory system is also important because it is needed in the calculation of emission factors, the other category of data needed for RELs/RLs.

The methods and tools for activity data and emission factor estimation recommended by UNFCCC/IPCC, including some general modalities for their estimation, are described in Annex A. However, the data needed by these tools and methods are not currently available in the format, quality, and accuracy needed according to UNFCCC/IPCC recommendations, particularly in terms of acceptable level of uncertainty (e.g., accuracy) and completeness. Specifically, Chapter 5, Section 5.2, of the IPCC Good Practice Guidance on Land Use, Land Use Change and Forestry (IPCC 2003) states,

> The definition of good practice requires that inventories should be accurate in the sense that they are neither over- nor underestimated as far as can be judged, and that uncertainties are reduced as far as practicable. There is no predetermined level of precision; uncertainty is assessed to help prioritise efforts to improve the accuracy of inventories in the future and guide decisions on methodological choice. Uncertainties are also of interest when judging the level of agreement between national inventories and emission or removal estimates made by different institutions or approaches.

UNFCCC/IPCC also recommends a stepwise approach to implementing REDD+ to allow countries like the Philippines to start with the data and technical infrastructures available, provided countries put themselves on a path to improve their data and their capacities to generate both the activity data and emission factors.

Two forest monitoring systems and forest inventory systems have been developed and applied in the Philippines and should be examined for potential applications. First is the FAO 2005 FRA system and the other is the system developed and applied through the GIZ pilot project (see Section 6). In addition, the work under the DENR/USAID/USFS Partnership is relevant. The report contains some practical recommendations pertaining to possible improvements of the forest monitoring and inventory systems in the Philippines.

12. BIBLIOGRAPHY

Acosta, R. (2005). *Brief on National Forest Inventory (NFI) for the Philippines.* Report submitted to FAO Global Resource Assessment Project. Rome, Italy: FAO.

Angelsen, A. (2008). How do we set the reference levels for REDD payments? In A. Angelsen (Ed.), *Moving ahead with REDD: Issues, options and implications* (pp. 53–63). Bogor, Indonesia: CIFOR (Center for International Forestry Research). Retrieved from http://www.cifor.org/publications/pdf_files/Books/BAngelsen0801.pdf

Anti-illegal logging checkpoints in Northern Mindanao. (2012, November 16). *Cagayan de Oro Sun.Star*. Retrieved from http://www.sunstar.com.ph/cagayan-de-oro/local-news/2012/11/16/anti-illegal-logging-checkpoints-northern-mindanao-253655

Brown, S. (1997). Estimating biomass and biomass change of tropical forests: a primer (UN FAO Forestry Paper 134), p. 55. Rome, Italy: FAO. Retrieved from http://www.fao.org/docrep/w4095e/w4095e00.htm

Burgonio, T. J. (2012, June 30). 31 DENR officials in Mindanao sacked over illegal logging, *Philippine Daily Inquirer*. Retrieved from http://newsinfo.inquirer.net/221029/31-denr-officials-in-mindanao-sacked-over-illegal-logging

Chave, J., Andalo, C., Brown, S., et al. (2005). Tree allometry and improved estimation of carbon stocks and balance in tropical forests. *Oecologia 145,* 87-99.

Climate Change Commission. (2011). *National framework strategy on climate change 2010-2022.* Malacañang: Office of the President of the Philippines. Retrieved from http://climate.gov.ph/index.php/documents/category/27-nfscc

Cortez, R., Saines, R., Griscom, B., et al. (2010). A nested approach to REDD+: Structuring effective and transparent incentive mechanisms for REDD+ implementation at multiple scales. Arlington, Virginia: Nature Conservancy. Retrieved from http://www.nature.org/media/climatechange/nested_paper_final_60110.pdf

Depasupil, W. B. (2013, July 10). Illegal loggers laugh all the way to the bank, *The Manila Times.* Retrieved from http://www.manilatimes.net/illegal-loggers-laugh-all-the-way-to-the-bank/17691/

Environmental Science for Social Change (ESSC). (2010, September 8). *Philippine forest cover 2002.* Philippines: ESSC. Retrieved from http://essc.org.ph/content/view/398/1

Food and Agriculture Organization (FAO). (2005). *Forest Resources Assessment, National Forest Assessment: Working Paper, National forest and tree resources assessment 2003-05,* Forest Resources Assessment Programme, Working Paper 96. Rome, Italy: FAO. Retrieved from http://www.fao.org/forestry/15603-0b641a2f5813896ac8a5220e5e8bc4106.pdf

Food and Agriculture Organization (FAO)/IIASA/ISRIC/ISSCAS/JRC. (2009). Harmonized world soil database (version 1.1), Rome, Italy: FAO and Laxenburg, Austria: IIASA. Retrieved from http://www.fao.org/nr/land/soils/harmonized-world-soil-database/en/

GOFC-GOLD. (2012). *A sourcebook of methods and procedures for monitoring and reporting anthropogenic greenhouse gas emissions and removals caused by deforestation, gains and losses of carbon stocks in forests remaining forests, and forestation,* GOFC-GOLD Report version COP16-1, GOFC-GOLD Project Office. Alberta, Canada: Natural Resources Canada. Retrieved from http://www.gofcgold.wur.nl/redd/index.php

Harris, N. (2011, November 9-10). Draft Methodological Framework for REDD+ Reference Levels. Winrock International. Presentation, Technical Workshop on Reference Levels for REDD+ World Bank. Retrieved from http://www.forestcarbonpartnership.org/fcp/sites/forestcarbonpartnership.org/files/Documents/PDF/Nov2011/1%20-%20Draft%20RL%20framework-Winrock-Nov8, 2011.pdf

Herold, M., Angelsen, A., Verchot, L. V., et al. (2012). A stepwise framework for developing REDD+ reference levels. In Angelsen, A., Brockhaus, M., Sunderlin, W. D., and Verchot L. V. (Eds.), *Analysing REDD+ challenges and choices.* Bogor, Indonesia: CIFOR. Retrieved from http://www.cifor.org/publications/pdf_files/Books/BAngelsen1201.pdf

IPCC. (2003). *Good practice guidance for land use, land-use change and forestry: National Greenhouse Gas Inventories Programme.* Penman, J., Gytarsky, M., Hiraishi, T., et al. (Eds.). Hayama, Japan: Institute for Global Environmental Strategies (IGES). Retrieved from http://www.ipcc-nggip.iges.or.jp/public/gpglulucf/gpglulucf_files/GPG_LULUCF_FULL.pdf

IPCC. (2006). *2006 IPCC guidelines for national greenhouse gas inventories,* prepared by the National Greenhouse Gas Inventories Programme. Eggleston H. S., Buendia, L., Miwa, K., et al. (Eds.). Hayama, Japan: Institute for Global Environmental Strategies (IGES). Retrieved from http://www.ipcc-nggip.iges.or.jp/public/2006gl/index.html

Lasco, R. D. (2001). Secondary forests in the Philippines: formation and transformation in the 20th century. *Journal of Tropical Forest Science 13*(4), 652–670.

Lee, D., Seifert-Granzin, J., Neeff, T., et al. (2011, September 27-29). Maximizing the co-benefits of REDD-Plus actions. Discussion paper for a Regional Expert Workshop supported by the German International Climate Initiative, Subic, Philippines.

Mendoza, G. A. (2012a). *Methodological approaches and future technical assistance needed to implement REDD+ effectively.* Report submitted to the ASEAN Secretariat under the project titled Strengthening ASEAN Mechanisms in Implementing REDD-plus. Jakarta, Indonesia: Association of Southeast Asian Nations (ASEAN).

Mendoza, G. A. (2012b). *Guidelines for the establishment of Reference Emission Level (REL) and measurement, reporting and verification (MRV) systems for implementing REDD+.* Report to the ASEAN Secretariat under the project titled Strengthening ASEAN Mechanisms in Implementing REDD-plus. Jakarta, Indonesia: Association of Southeast Asian Nations (ASEAN).

Mendoza, G.A. (2012c). *Economic incentives and financing mechanisms in implementing REDD+.* Report submitted to the ASEAN Secretariat under the project titled Strengthening ASEAN Mechanisms in Implementing REDD-plus. Jakarta, Indonesia: Association of Southeast Asian Nations (ASEAN).

Meridian Institute. (2011a). *Modalities for REDD+ Reference Levels: Technical and procedural issues.* Prepared for the Government of Norway by Angelsen, A., Boucher, D., Brown, S., et al. Retrieved from http://www.redd-oar.org/links/RL_report.pdf

Meridian Institute. (2011b). *Guidelines for REDD+ Reference Levels: Principles and recommendations.* Prepared for the Government of Norway by Angelsen, A., Boucher, S., Brown, S., et al. Retrieved from http://www.redd-oar.org/links/REED+RL.pdf

MESA Consult. (2011). *Proposal of an operational forest carbon monitoring design.* Climate Relevant Forest Policy and Piloting of REDD+, German Technical Cooperation with the Philippines. Manila: German International Cooperation Agency (GIZ).

Miles, L., Kabalimu, K., Bahane, B., et al. (2009). *Carbon, biodiversity and ecosystem services: exploring co-benefits. Tanzania*. Prepared by United Nations Environment Programme – World Conservation Management Centre (UNEP-WCMC), Cambridge, UK & Forestry and Beekeeping Division, Ministry of Natural Resources and Tourism, Dar es Salaam. UN-REDD Programme, Tanzania. Retrieved from http://www.unep-wcmc.org/medialibrary/2010/10/05/7281a6c1/Tanzania%20brochure%20final%20110617.pdf

Parrotta, A., Wildburger, C., & Mansourian, S. (Eds.). (2012). *Understanding relationships between biodiversity, carbon, forests and people: The key to achieving REDD+ objectives.* A global assessment report. Prepared by the Global Forest Expert Panel on Biodiversity, Forest Management, and REDD+. IUFRO World Series Volume 31. Vienna. 161 pp.

Pedroni, L. (2007, October 24-25). The "nested approach": A flexible mechanism to reduce emissions from deforestation. Presentation at the International Roundtable on Reducing Emissions and Deforestation in Developing Countries. Brussels, Belgium. Retrieved from http://www.climatefocus.com/downloads/4.TheNestedApproach.pdf

Pedroni, L., Streck, C., Estrada, M., and Dutschke, M. (2007). The "nested approach": A flexible mechanism to reduce emissions from deforestation. Turrialba, Costa Rica: Centro Agronómico Tropical de Investigación y Enseñanza (CATIE).

Petrova, S. H., Swails, E. N., Walker, S. M., and Brown, S. (2010). *Manual addressing technical issues related to implementing REDD+ programs in Mekong countries.* Prepared by Winrock International. Washington, DC: Asia Regional Biodiversity Conservation Program (ARBCP), USAID. Retrieved from http://www.pnae.mg/mrv/attachments/article/52/arbcp_redd_manual2010.pdf

Union of Concerned Scientists. (2011). *The root of the problem: What is driving deforestation today?* Retrieved from http://www.ucsusa.org/assets/documents/global_warming/UCS_RootoftheProblem_DriversofDeforestation_FullReport.pdf

U.S. Forest Service (USFS). (2011). *Sustainable landscapes assessment for the Philippines.* Manila, Philippines: USAID. Retrieved from http://www.fs.fed.us/psw/publications/cordell/psw_2011_cordell002(agoncillo).pdf

U.S. Forest Service (USFS). (2012). *USFS forest inventory technical support to the Philippines.* Manila, Philippines: USAID.

Walker, S. (2012, March 20). Introduction to RL and MRV. Presentation at Lowering Emissions in Asia's Forests, Hanoi, Vietnam.

Warpole, P. (2010, July). *Figuring the forest figures: Understanding forest cover data in the Philippines and where we might be proceeding.* Philippines: Environmental Science for Social Change (ESSC). Retrieved from http://download.essc.org.ph/forest/ESSC-PWalpole_Figuring%20forest%20figures_reduced_.pdf

ANNEX A: METHODS AND TOOLS FOR REDD+ IMPLEMENTATION

This annex provides a general overview of the methods and tools related to REDD+ implementation proposed by international bodies that oversee the implementation of REDD+ (e.g., the SBSTA of the UNFCCC/IPCC/COP). To date, no specific modalities have been approved by all parties through the UNFCCC/COP. However, some basic procedures that have already undergone peer reviews for technical soundness have been published and are currently used as guidelines for early projects—in particular, the IPCC Guidelines (2006) Volume 4, dealing with Agriculture, Forestry and Other Land Use (AFOLU), and the 2003 IPCC Good Practice Guidance for Land Use Change and Forestry. These two guides contain very specific information about methods, equations, and tools. In addition, the GOFC-GOLD Sourcebook (2012) contains technical descriptions of the tools and methods for REDD+ implementation.

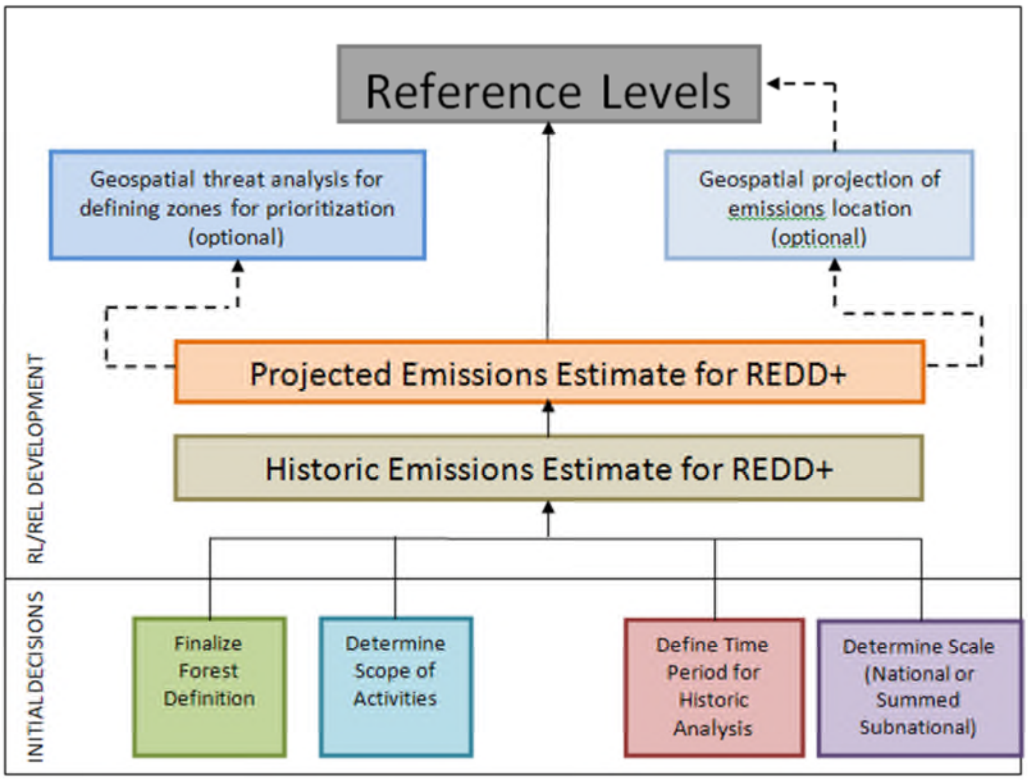
There are two important elements of REDD+ with requirements for technical methods and tools: (1) setting national baselines or reference emission levels (RELs/RLs); and (2) setting up a monitoring system to ensure a credible MRV system. To date, no guidelines or methods for setting reference levels have been agreed upon by relevant agencies. There are, however, broadly defined principles at the UNFCCC level on how reference levels can be established. There is also very little guidance at the international level about standards or modalities in the setting of reference levels.

In addition to setting the reference levels, the design of a suitable MRV system is also critical, as it provides the means to monitor the implementation of REDD+ interventions. The system should be capable of credibly monitoring the performance of nations implementing REDD+ in terms of how well the REDD+ interventions are working, particularly with respect to the reference levels. The subsections that follow describe these REDD+ elements.

A.1 SETTING OF RELS/RLS

The steps for setting RELs/RLs can be observed from Figure 1, which is taken from Harris (2011) and Walker (2012). The framework presented in Harris (2011) provides a layout of the important components, the data needed, and the logical framework describing the relationships among the RL components.

FIGURE 1. REFERENCE LEVEL FRAMEWORK



Source: Harris (2011).

Figure 1 shows that RELs/RLs have two determining components: historic emissions and projected emissions. In addition, in estimating emissions, four important initial decisions have to be made to guide the estimation of the total emissions: (1) Forest Definition, (2) Scope of Activities, (3) Period of Historic Analysis, and (4) Scale of Implementation. These initial decisions are described briefly below. Where appropriate, the data requirements are indicated.

A.1.1 FOREST DEFINITION

This decision involves defining areas considered to be forests. This is significant because it will determine what will be considered "forests" for purposes of determining carbon emissions or removals and also for monitoring changes in forest cover through time. The Philippines will have to decide what method or definition to use. Under the UNFCCC, the category of forestland includes all land with woody vegetation consistent with the threshold used to define forestland. For instance, in its Forest Resources Assessment of 2010, FAO defined forest area as having a minimum cover of 10 percent, height of 5 m, and area of 0.5 ha, with forest use as the predominant use. In other words, countries may adopt the FAO definition, or other definitions provided they are transparent (clear about how they define their forest) and consistent (they use the same definition in REL establishment and in monitoring (MRV).

A.1.2 SCOPE OF ACTIVITIES

The five eligible activities to consider for REDD+ include deforestation, forest degradation, carbon conservation, sustainable forest management, and carbon stock enhancement.

While it is most complete to include all eligible REDD+ activities in the RLs/RELs, data and/or resources may not be available to include all activities. Countries should include "significant" activities and provide justification for excluding activities. UNFCCC also allows a stepwise approach where, initially, some activities may be excluded but should be included as data become available and the country's capabilities improve. In other words, it may make sense for the Philippines to start first with the REDD+ interventions that will have the most significant impacts, adding additional activities into the RLs/RELs (as well as intervention programs to address these) as time, data, and resources allow.

In addition to the eligible REDD+ activities, countries must specify which carbon pools to include. The following are the IPCC recommended and identified carbon pools: aboveground biomass, belowground biomass, soil carbon, litter, and deadwood.

A.1.3 PERIOD OF ANALYSIS

The period of analysis selected will serve as the basis for estimating historical emissions, particularly the rate of deforestation. Because of the periodic variation in the rate of deforestation, it is likely that estimated emissions will be sensitive to or can be affected by the period selected as reference. For example, selecting a decade in which the rate of deforestation was high will skew the estimated periodic deforestation upward. Some adjustments may be needed to remedy the possible bias in selecting the period.

A.1.4 SCALE OF IMPLEMENTATION

The basic decisions described above related to the setting of RLs/RELs are relevant to the scale of REDD+ implementation, whether at national or subnational scales. UNFCCC/COP requires reporting at the national level, but countries may opt to work on their historic emission and removal data in a stepwise fashion. This means countries like the Philippines can start with selected states or provinces where changes in forest cover have historically been high. Similarly, and as indicated above, countries may also start with one activity such as deforestation where suitable remote sensing data are freely available.

The UNFCCC and COP, along with a number of developing countries, advocate a national approach. Proponents of national-level implementation (i.e., those who favor allowing only national governments to receive direct REDD+ incentives) assert that national-level interventions for REDD+ are essential to achieving the large-scale systemic reforms across ministries within the national government that are needed to effectively reduce deforestation and forest degradation. Additionally, proponents have also expressed concern that subnational approaches face greater challenges with addressing leakage and permanence than national-level approaches (Angelsen 2008). This concern may reflect the previous experiences of many developing countries with respect to leakage, displacement and transaction costs.

The subnational approach proposes that REDD activities would be implemented in a defined geographical area, or as projects, by individuals, communities, NGOs, private companies, or national or local governments. Proponents of implementing REDD+ at the subnational scale argue that most activities are currently implemented and monitored at the project level; hence, it is best to start REDD+ implementation at the project level. Subsequently, activities should also be credited at the subnational level, as these activities are generally monitored at the project level. Countries can build capacities to create national accounting frameworks, while taking near-term steps to reduce deforestation and forest degradation. Additionally, investing directly in subnational activities is perceived as more attractive for most private investors. Finally, and perhaps most importantly, many recognize that providing direct incentives to subnational activities will motivate greater participation by actors with direct control over land-use decisions, including subnational governments, indigenous peoples and forest-dependent communities, and landowners/users. It should be noted that while UNFCCC/COP aims for REDD+ at the national level, the subnational approach is also allowed as an interim measure. UNFCCC/IPCC guidelines state that countries must simply put themselves on a 'path' to be able to eventually implement REDD+ at the national level.

To take advantage of the stepwise approach, it may be advantageous for the Philippines to adopt the nested approach (Mendoza 2012c). Under a national approach, incentives (credits or funding) flow to the national government based on performance against a national reference level. On the other hand, in a subnational approach, incentives flow to a subnational governmental entity such as a state, municipality, province, or district based on performance measured against a subnational reference level. Or, on a project level, incentives flow directly to the project based also on performance measured against a project-based reference level. From a geographical perspective, a project does not necessarily coincide with a governmental, political, or administrative jurisdiction (Cortez et al. 2010). Though there are concerns with the nested approach about a reduction in incentive payments at the local level due to national governments taking a cut, approaches to address this issue, including benefit-sharing distribution systems, are currently being proposed in the Philippines.

Given the wide range of circumstances among nations, it may be best to integrate subnational activities into a national accounting framework through a "nested" approach as first proposed by Pedroni (2007). This approach allows the implementation of REDD+ at multiple scales, including national, subnational, and project. Under this approach, it is possible for countries to get started with REDD+ activities at any level. Those that decide to start at the subnational level could scale up to a national approach as better data become available and as their technical capacity improves, including stronger governance—typically referred to as a "bottom-up" approach. Moreover, it is also possible that countries with projects that can qualify as a potential REDD+ project can get started even without an established national reference level, as long as the country can set an estimate of a project-based reference level. It should be noted that transitioning to a national approach will eventually be mandatory to receive international funds, as agreed upon at UNFCCC/COP. Although transitioning to a national approach is obligatory, it is still possible to credit individual project activities or subnational projects under the nested approach. The nested approach therefore has two unique features: first, the ability to scale up from a subnational to a national approach over time and, second, the option to account for and receive international credits at subnational and national levels simultaneously (Angelsen 2008).

A.2 ACTIVITY DATA AND EMISSION FACTORS IN REL/RL DEVELOPMENT

Meridian Institute (2011b) has noted that the IPCC Good Practice Guidance (GPG) offers two basic inputs with which to generate inventories that allow measurement and quantification of GHG emissions and removals; namely, *activity data* and *emission factors*. These two inputs enable the establishment of REL/RL.

The IPCC Guidelines (2003, 2006) contain some basic methods and also default information for activity data and emission factor determination, as well as methods for carbon accounting and estimation. The sections that follow describe some of the basic concepts and methods.

Activity data refer to the extent or scope covered by all emissions and removals of GHGs. Considering the three eligible activities described earlier, activity data refers to the areal extent of those activities; specifically, the area change data expressed in hectares per year. Furthermore, area change data must be expressed in terms of gross changes, and these changes could also be spatially explicit to allow tracking or spatial monitoring in the future.

Emission factors refer to GHG emissions or removals per unit area (e.g., tons of carbon emitted per hectare of deforestation). The emission factors are derived from assessments of the changes in the carbon pools. These can be estimated at different time periods. Furthermore, emissions or removals of carbon due to land conversion to other uses can be determined by one of two methods: (1) the difference in carbon stocks (i.e., the difference between forest and annual cropland); or (2) the difference between the gain and loss of carbon (e.g., loss due to harvesting and regrowth) as described in Meridian Institute (2011b).

A.2.1 ACTIVITY DATA ESTIMATION

IPCC (2006) describes three approaches in determining the activity data, or the change in the area of the different land categories. Approach 1 identifies the total land area in each category. These data, which may come from national statistics and are most likely non-spatial (i.e., not location-specific), do not provide for specific information on the nature and area of conversions between land uses. In other words, they are only "net area" changes (i.e., deforestation to forestation). Approach 2 involves more explicit tracking of land uses and changes, or land conversion between categories resulting in a non-spatial or location-specific conversion matrix from one land use to another. Approach 3 extends Approach 2 to include spatially explicit tracking of land conversion, which could be obtained either through sampling or wall-to-wall mapping.

A.2.2 EMISSION FACTOR ESTIMATION

Emission factors are derived from assessment of the changes in carbon stocks in the various carbon pools as shown earlier. IPCC (2006) provided three methods or tiers for estimating emission factors as follows:

- Tier 1: Use of IPCC default factors
- Tier 2: Use of country-specific data for key factors
- Tier 3: Use of actual inventories with repeated measurements

Tier 3 is not in use in the Philippines, or in any developing countries, due to its intensive data requirements. Most countries use Tier 1; however, they must put themselves into a position to move to the use of Tier 2.

Tier 1 factors are the simplest to use because no new data are required. Default values for forest biomass and biomass Mean Annual Increment (MAI) can be obtained from IPCC's Emission Factor Database (i.e., a conversion factor for biomass to carbon for different biomes). For deforestation, the Tier 1 emission factor can be estimated using the Stock Difference method (see Section A.2.3). For forest degradation, Tier 1 applies the Gain-Loss method using the default MAI combined with losses from wood removals and disturbances, with transfers of biomass to dead organic matter estimated using default equations (GOFC-GOLD 2010, Section 2.3.3.1).

Tier 2, on the other hand, is similar to Tier 1 because it uses "static" forest biomass information, but it improves on the approach by using country-specific data collected from each forest instead of the default values used in Tier 1. If applied well, the Tier 2 method can yield significant improvements over Tier 1 particularly in improving accuracy and reducing uncertainty.

Tier 3 is the most rigorous, requiring the most data and the highest level of effort. The Tier 3 method requires actual inventories with repeated measures of sampling plots in order to directly measure changes in forest biomass. Alternatively, it may also use models in combination with plot data to estimate forest biomass. Tier 3 focuses on measurements of trees only, and uses region/forest-specific default data and modeling for the other pools. The Tier 3 method, to be effective, requires repeated measurement; hence, long-term commitments of resources and personnel are also necessary. Thus, the Tier 3 approach can be expensive for a developing country such as the Philippines to sustain. To estimate emissions from degradation, in contrast to Tier 1, the Tier 3 method uses the Stock Difference method, where change in forest biomass stocks is directly estimated from repeated measures, possibly in combination with models (GOFC-GOLD 2010, Section 2.3.3.1)..

A.2.3 METHODS FOR ESTIMATING CARBON STOCKS

There are two general methods for estimating carbon stock changes: (1) the stock-based, stock-change, or Stock Difference method and (2) the process-based or Gain-Loss method. Both methods can be used to estimate stock changes in any carbon pool, although they are not well suited for soil carbon stocks (GOFC-GOLD 2010, Section 2.4.4).

Stock Difference Method

$$\Delta C = \frac{(C_{t2} - C_{t1})}{(t_2 - t_1)}$$

Where:

ΔC = annual carbon stock change in pool (tC/yr)

C_{t1} = carbon stock in pool in at time t_1 (tC)

C_{t2} = carbon stock in pool in at time t_2 (tC)

In general, as the name implies, the stock-based approach estimates the difference in carbon stocks in a particular pool measured at two points in time. This method is particularly suitable when the amount of carbon stocks from relevant carbon pools have been measured and estimated over time. Data needed for such calculations can be obtained from national forest inventories. Because of the basic structure of the Stock Difference method, which requires estimation of carbon stocks at two different time periods, it is better suited for measuring emissions from deforestation and forestation.

Gain-Loss Method

$$\Delta C = \Delta C_G - \Delta C_L$$

Where:

ΔC = annual carbon stock change in pool (tC/yr)

ΔC_G = annual gain in carbon (tC/yr)

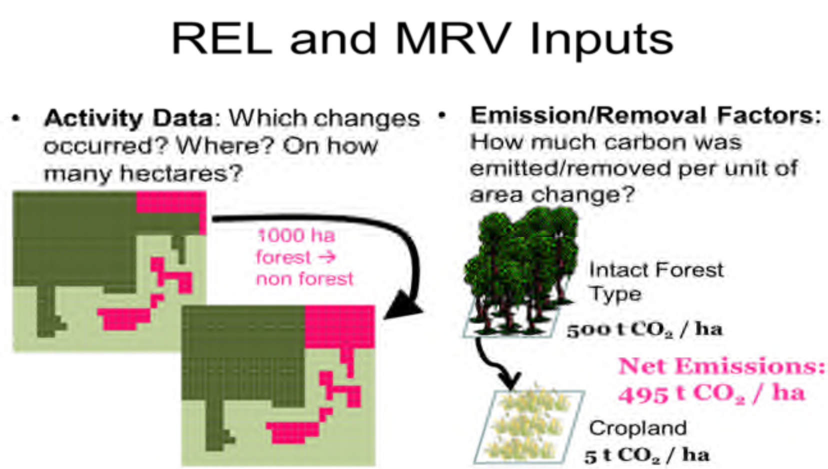
ΔC_L = annual loss of carbon (tC/yr)

The process-based or Gain-Loss method calculates the carbon stock change by taking the difference (i.e., net balance) between all additions to and removals from the carbon pool. Obviously, gains from living biomass are due to vegetation. There may also be gains from the other carbon pools due primarily to transfers from other pools (e.g., transfer from a biomass pool to dead organic matter due to decomposition and other forms of disturbance). Because it measures carbon stock change and not gross carbon stock from each carbon pool, the Gain-Loss method is better for measuring forest degradation, sustainable forest management, and conservation of carbon (i.e., forestlands remaining as forestlands).

A.3. SETTING REFERENCE EMISSION LEVELS/REFERENCE LEVELS

To fully account for the total emissions, the easiest way to calculate is simply to multiply the activity data by the emission factors (see Figure 2).

FIGURE 2. REL AND MRV INPUTS



Source: Adapted from Walker (2012).

From Figure 2, assume that both the activity data, which should include what changes occurred (e.g., forest was converted to cropland), and the emission/removal factors, have been determined. For example, in terms of activity data, 1,000 hectares of forest was converted to non-forest. The emission factor calculated for intact forest is 500 tCO_2. The land use change or conversion to agriculture resulted in 5 tCO_2 of carbon sequestered; hence, the net emission factor is 495 tCO_2.

ANNEX B: DATA NEEDS AND REQUIREMENTS FOR REDD+ IMPLEMENTATION

This annex discusses data needs and requirements for REDD+ implementation. First, data are needed for the initial decisions or concerns that must be addressed, namely:

Forest Definition: Once the manner by which forests are defined is decided, it will be important to identify the sources of data that will be used to create forest cover maps. These data sources will primarily be aerial photographs or satellite imagery. It will also be important to document how forest cover maps are delineated, the methods used to classify forest cover (e.g., image classification techniques, image interpretation tools used). Part of this data need will be a benchmark map that should serve as the initial forest cover map.

Scope of Activities: Much data will be needed for the Philippines to make an informed decision on activities to include in its REDD+ program. Very likely, the Philippines will include only deforestation among the eligible activities because of paucity of data for the other activities. However, given the UNFCCC/COP's recommendation of a stepwise approach, the Philippines will need to improve its data and technical capability to be able to eventually include the other REDD+ eligible activities. In fact, the Philippines stands to benefit from the "plus" aspects of REDD because of its national ongoing programs: namely, the National Greening Program NGP and the Logging Moratorium (EO 26). The NGP can be an excellent candidate for funding under the carbon stock enhancement activity of REDD+, while the logging moratorium policy can be a candidate under the carbon REDD+ conservation activity. Hence, data pertaining to planted areas in the NGP and protected areas in EO 26 will be needed.

Forest degradation is also an important source of emissions in the Philippines. Data needed to assess degradation should therefore be explored. Most likely, medium- to high-resolution remotely sensed data will be needed for assessing forest degradation. Alternatively, medium-resolution, in combination with coarse-resolution, data may be used as well.

Period of Analysis: UNFCCC/COP strongly recommends obtaining data for at least two, preferably three, time periods within a span of at least a decade to provide an adequate basis for the historical emission estimate. UNFCCC/COP also recommends that the data used should not be too old (e.g., preferably no older than 10 years). Most Southeast Asian nations have used or are planning to use 1990, 2000, 2005, or 2010 data. For the Philippines, the FAO Forest Resources Assessment data for 2003, published in 2005, could be a part of the dataset.

Scale of Implementation: To establish RELs/RLs at the national or subnational level will require significant amounts of data, which may be categorized into two groups: activity data and emission factors. Both types of data must be generated to enable estimation of RELs/RLs, whether at the national or subnational level. The preceding sections provide more detail about these two types of data as described in Annex A.2.1 and A2.2.

B.1 DATA NEEDS FOR ESTIMATING EMISSION FACTORS

Meridian Institute (2011b) recommends that developing countries should start setting RELs/RLs by developing scientifically credible estimates of their historic emissions and removals based on data collected according to accepted standards. Total accounting of emissions can be determined by combining the activity data and the emission factors per unit area.

Meridian Institute (2011b) has summarized some of the relevant data needed for the establishment of reference levels (see Table 3). Note that high resolution satellite imagery is not currently available in the Philippines, but plans are in place to acquire light detection and ranging (LIDAR) data.

TABLE 3. COLLECTION OF RELEVANT DATA FOR REDD+ REFERENCE LEVELS

Type of Data	Source of Data	Analytical Steps
Spatially explicit data for stratifying lands	Maps of biophysical factors (e.g., vegetation, elevation and slope, climate zones), disturbance history (e.g., past logging), transportation networks, population centers, forest management designations (e.g., production, protection).	Generate geo-referenced spatial factor, maps, overlay on remote sensing products to delineate forest areas with similar characteristics (i.e., strata).
Spatially explicit activity data on gross deforestation and gross forestation	Time series of remote sensing products for a minimum of 3 times within at least 10 years (e.g., freely available Landsat data since 1990).[1]	Develop forest/non-forest cover map for beginning year with quantified accuracy. Use change-detection method to obtain gross loss and gross gain in forest cover for each time interval in map and tabular formats (e.g., ha/yr for 2000–2005 and 2005–2010).
Activity data for forest degradation[2] and carbon stock enhancement	*Selective logging:* Maps of concession areas and forest cover, and multi-year medium- to high-resolution remote sensing products and/or reliable historic records of timber extraction rates (m3/yr).	Estimate areas being logged from manual or automatic delineation of changing road network in forest areas; change in canopy characteristics from tree gaps/skid trails in high-resolution imagery. Field measures of losses of biomass carbon in gaps (e.g., t C/ m3 extracted) due to tree felling and collateral damage combined with annual rates of timber extraction.
	Escaped fires: Multi-year medium to high resolution imagery of fire products coupled with optical imagery.	Manual or automatic delineation of burn scars to obtain area burned.
	Low-level wood extraction for fuel or local use:	Manual or automatic interpretation of change in canopy characteristics from

Type of Data	Source of Data	Analytical Steps
	Very high-resolution satellite imagery.	tree gaps and small trails to detect degrading activities.
	Tree planting: Area and location of each type of activity (e.g., reforestation, enrichment planting, trees outside forest) by species types and age.	Compile and summarize data into strata (e.g., location plus species type plus age class) that relate to their carbon stocks.
Key agents or proximate drivers of deforestation and degradation[3]	Remote sensing imagery used for deforestation and forest degradation assessments, other map layers of transportation networks and population centers.	Assess characteristics of post-clearing land cover: large clearings (e.g., >25 ha) are likely to be industrial-scale agriculture; small clearings are likely to be smallholder farmers and shifting cultivators; seasonal patterns in "greening" indicate annual versus perennial crop versus grassland, etc. Manual delineation of expanding road network, population centers, or timber extraction activities.
Analysis of key pools	Estimates of carbon (C) stocks in all non-soil pools from existing data or newly collected data from field pilot plots. For soil pool, estimates of soil C stock to 30 cm depth in forest strata likely to be converted to agriculture, (e.g., from forest to annual crops; from soil sampling in forests typical of those deforested during historic period; and from the Harmonized World Soil Database).[4]	
Estimates of emission factors for each stratum	Appropriate allometric equations for forests.	
	Good-quality existing data from forest inventories or other studies with good coverage for each stratum or statistically sound field data collected for all selected pools.	Compile existing allometric equations, validate their suitability for national forests or derive new ones if not valid. For each stratum, convert measurements (from inventories, from other studies, or new field data collection system) to C stock estimates using the biomass expansion method[5] or using allometric equations. Estimate emission factors by the stock-change or gain-loss method.

Source: Adapted from Meridian (2011b, pp. 5-6).
Notes:
[1] See: http://landsat.gsfc.nasa.gov/data/
[2] Not all degrading activities are included here, but rather the focus is on those activities that have a large enough effect that they can be detected using available techniques.
[3] These data are needed to estimate the emission factors for different agents/drivers of land cover change. Agro-industry tends to clear large land areas, reduce the carbon stocks in vegetation to near zero, and significantly impact soil carbon stocks; whereas small-scale farmers tend to clear many small patches of land, often burn the vegetation and leave remnants of forest behind, and have less impact on soil carbon.
[4] FAO (2009). This global data set shows the spatial distribution of generalized soil classes as defined for IPCC Tier-I level national greenhouse gas inventory assessments.
[5] See, for example, Brown (1997) or the method in IPCC (2006).

B.2 DATA NEEDS FOR ESTIMATING HISTORIC EMISSIONS

Meridian (2011a) summarizes the data needed for estimating historic emissions and GHG inventories as shown in Table 4. The "issues" refer to concerns raised on each of the data required for estimating past and future emissions, including the need for additional monitoring depending on the definition of forest cover, challenges in estimating carbon stocks, differences in measuring and monitoring costs, variability in time frames used for estimating historic emissions, the challenges of obtaining rates of forest degradation or enhancement of carbon stocks, variability in agents of land cover change, and a lack of suitable databases of spatial data on biogeographical factors.

IPCC carbon pools include: above ground biomass, below ground biomass, soil carbon, litter, and wood debris. Above ground biomass refers to the biomass of the living tree (e.g., crown, stems, twigs); below ground refers to the root system; soil carbon refers mainly to the organic carbon on the top soil horizon; litter refers to dead organic material on the soil surface; wood debris refers to decomposing wood lying on the forest floor.

TABLE 4. DATA REQUIREMENTS FOR ESTIMATING HISTORIC EMISSIONS AND GHG REMOVALS

Data Required	Need Addressed	Issues
Definition of forest[22]	Determines which lands to include in REDD+ activities.	Definition of forests with low thresholds for forest cover, height, and minimum area ensures that practically all lands that contain trees could be eligible for REDD+ incentives. Defining forests in a way that encompasses more lands in the historic period can cost more in future monitoring.
Carbon stocks of forests and nonforests and carbon gains (forest growth) and losses (e.g., extraction of trees for timber and fuel) that represent the historic time period	Estimates the emission factors for each relevant REDD+ activity.	Few countries have robust estimates, with low uncertainty, of carbon stocks in forests at scale (e.g., forest volume inventories are not national; data from research plots do not permit extrapolation to larger scales). Data on extraction of trees for timber or fuel are not well tracked and have large inconsistencies; forest growth after tree removal is very poorly known.
Key category analysis of carbon pools	Determines which of the five IPCC pools to include.[23]	Broad range in the magnitude, variability, and significance (relative to the total stock) of the five forest carbon pools, resulting in different measuring and monitoring costs.
Time period for estimating historic emissions	Establishes an appropriate time over which to account for varying emissions and removals.	Should all countries use same fixed time period that starts after some fixed year? A longer time frame may be needed under special circumstances (e.g. where there have been conflicts > 5 years ago followed by periods of increased economic activity, or the opposite trend).
Interpreted remotely sensed data products for forest cover/ forest use (FC/FU) for the historic time period	Estimates the historic rate and location of FC/FU change.	Deforestation can be measured with existing satellites since 2000 and even better with the launch of newer sensors that can penetrate clouds. Obtaining rates of forest degradation or enhancement of carbon stocks in existing forests is challenging as many changes cannot be detected in commonly available imagery.[24] Areas of A/R generally are well tracked historically by countries.
Key agents or drivers of forest cover change	Estimates how agents/drivers of land cover change impact the change in carbon stocks.	Agro-industry tends to clear large land areas, reduce the carbon stocks in vegetation to near zero, and significantly impact soil carbon stocks. Small-scale farmers tend to clear many small patches of land, often burning the vegetation and leaving remnants behind, and have less impact on soil carbon.
Spatial data on biogeographical factors (e.g. elevation and slope, soil suitability, agroecological zones, natural disturbances, transportation networks, towns)	Useful for verification and quality assessment of activity data and emission factors.	Suitable data bases are not available for all countries or at the appropriate scales.

Source: Meridian (2011a).

B.2.1 COMPILATION OF EXISTING DATA ON FOREST CARBON STOCKS AND EMISSIONS

Existing data from current forest inventory systems should be examined first and evaluated against the criteria of accuracy and precision targets and spatial coverage of measurements. After data from the existing forest inventory are examined and completed, data gaps should be identified to serve as guides for designing a data collection and measurement plan. Petrova et al. (2010) describe the proper steps to compile existing historical data into a more structured database, while identifying relevant and practical carbon pools to include in the compiled inventory and also gaps where more data are needed.

B.2.2 STRATIFICATION OF FOREST LAND COVER CLASSES BY CARBON STOCKS

Mendoza (2012a, b) describe the process of stratifying land cover class based on carbon stocks. Land classes are seldom homogeneous with respect to forest carbon stocks because forest carbon stocks vary by forest type and ecological regions depending on physical factors such as soil type, vegetation type, precipitation, elevation, slope and aspect, drainage, disturbance history, rural population density, distance to transportation networks or settlements, distance to deforested land or forest edge, and other factors (GOFC-GOLD 2012, Chapter 2.3). Mendoza 2012a also describes how to conduct stratification, which in the end allows the generation of a carbon stratum map. Associating a given area of deforestation or degradation with a specific carbon stock that is relevant to the location where deforestation or degradation will most likely occur will result in more accurate and precise estimates of carbon (Petrova et al. 2010).

Stratification, in general, refers to the process of dividing heterogeneous forestland (or landscape) into distinct but adequately homogeneous subdivisions. Subdividing into groups is based on a common aggregation factor. Because the primary concern is carbon stock estimation, the common aggregation factor is the stock of carbon (e.g., carbon density) in the vegetation. Hence, if the forestland under consideration has multiple forest types, stratification must be done first and should be considered in designing a sampling scheme for estimating carbon emissions associated with deforestation and forest degradation. Indeed, stratification is a critical step that will enable the correlation or association of an activity data (deforestation and degradation) with stratum-specific carbon stock and help ensure more accurate estimation of carbon stock.

B.2.3 ASSESSMENT OF EXISTING FOREST CARBON STOCK DATA

As described in Section 3, the Philippines has conducted several nationwide forest inventories, albeit designed for other purposes than REDD+. There have also been a number of studies (e.g., on growth and yield, stand, and stock tables) that could be valuable sources of information for emission factor calculation. Hence, it is recommended that the Philippines thoroughly review existing data from forest inventories and scientific studies to determine how they can be used for emission factor estimation. For instance, many graduate researches from the University of the Philippines, College of Forestry and Natural Resources, and publications from the Ecosystem Research and Development Bureau, and the Philippine Council for Agricultural and Resources Research Development.

GOFC-GOLD (2010) and Petrova et al (2010) recommended that for existing data to be used in estimating emission factors, it is best if: "data are not more than 10 years old, data were derived from multiple measurement plots, all species are included in the inventories, data are sampled from good coverage of the strata over which they will be extrapolated, and the uncertainty level is acceptable."

Stand tables: Stand table data from a traditional forest inventory can provide useful data for the calculation of tree carbon stock estimates. Generally, stand tables include a count of all trees in a series of diameter classes. The method for converting stand table data to carbon stock data basically involves estimating the biomass per average tree of each diameter class of the stand table (measured as diameter at breast height (DBH)), multiplied by the number of trees in the class, and summing across all classes. The midpoint diameter of the class can be used to compute biomass using an allometric biomass regression equation.

Stock tables: Instead of, or in addition to, the stand tables, stock tables of merchantable timber volume may be available, often by diameter class. If stand tables are not available, it is likely that volume data are available if a forestry inventory has been conducted somewhere in the country. In many cases, stock tables will include volume of commercial species only. If this is the case, then these data cannot be used for estimating carbon stocks, as a large and unknown proportion of total volume and therefore total biomass is excluded.

Biomass density can be calculated from volume over bark (VOB) of merchantable growing stock wood by "expanding" this value to take into account the biomass of the other aboveground components—this is referred to as the Biomass Conversion and Expansion Factor (BCEF). When using this approach and default values of the BCEF provided in IPCC (2006), it is important that the definitions of VOB match. The values of BCEF for tropical forests in IPCC (2006) are based on a definition of VOB as follows:

Aboveground biomass (AGB) in tons per hectare (t/ha) is then estimated as:

$$AGB = VOB * BCEF$$

where:

BCEF t/m^3 = biomass conversion and expansion factor (ratio of aboveground oven-dry biomass of trees (t/ha) to merchantable growing stock volume over bark (m^3/ha)). Values of the BCEF are given in Table 4.5 of IPCC (2006).

ANNEX C: COMPLEMENTARY PROJECTS TO THE AILEG FORESTRY DATA ASSESSMENT AND REDD+ PROJECT

The AILEG Project[4] has coordinated with the following complementary efforts in the Philippines:

- The Low-Emission Asia Development Program of USAID's Regional Development Mission for Asia[5] supports developing countries in Asia in achieving long-term, transformative development and accelerating sustainable, climate-resilient economic growth while slowing the growth of GHG emissions. The LEAD Program supports and enhances country-led development programs, plans, and policies. It complements efforts of other international donors and organizations to support LEDS by building the capacity of government and non-governmental partners in developing and using LEDS in four interrelated areas: analysis and modeling of economic development pathways, emissions trajectories, and technology options; GHG inventories and accounting; carbon market development; and regional cooperation. The program is demand-driven and tailors its activities to specific country circumstances in up to 11 partner countries: Bangladesh, Cambodia, India, Indonesia, Laos, Malaysia, Nepal, Papua New Guinea, the Philippines, Thailand, and Vietnam.
- USAID recently signed a contract for implementation of the Biodiversity and Watersheds Improved for Stronger Economy and Ecosystem Resilience Program[6]. The objectives of the B+WISER Program are to (1) conserve biodiversity in forest areas; (2) reduce forest degradation in targeted priority watersheds; (3) build capacity to conserve biodiversity, manage forests, and support low-emission development; and (4) contribute to disaster risk reduction at the subnational level. The B+WISER Program is expected to achieve the following results: protection and conservation of biodiversity and critical habitats improved; governance of key biodiversity areas and watersheds strengthened; GHG emissions sequestered through improved forest and management and reforestation; long-term capacity of national and local institutions for adaptive planning and natural resource management enhanced; economic incentives and benefits to local communities from forests and biodiversity increased; relevant policies, laws, agreements, or regulations enacted or adopted; public and private participation in natural resource management increased; capacity of academic institutions and government institutions for scientific and policy research enhanced; and risks from natural disasters reduced. This five-year project began implementation in the first quarter of 2013.

[4] http://www.abtassociates.com/newsreleases/2012/abt-associates-to-help-countries-invest-in-low-emi.aspx
[5] http://www.lowemissionsasia.org/
[6] http://www.chemonics.com/OurWork/OurProjects/Pages/Biodiversity-and-Watersheds-Improved-for-Stronger-Economy-and-Ecosystem-Resilience-.aspx

- Through a partnership with USAID, EPA is providing assistance in the Philippines to complete the Agriculture and Land Use[7] Workbook on forest-related data and information for the Philippines GHG inventory.
- Under the DENR/USAID/USFS Partnership, the U.S. Forest Service is providing technical assistance and capacity building for a national inventory system and the creation of an MRV system for REDD+. A number of training workshops and seminars have already been conducted, all aimed at assisting FMB-DENR and UN-REDD in their efforts to craft forest inventory and monitoring systems supportive of the Philippines' REDD+ program. Tools such as remote sensing, spatial analysis, and forest inventory design have been presented for this purpose.
- GIZ is also implementing a REDD+ demonstration project[8] with heavy emphasis on forest inventory, monitoring, and carbon assessments (see Section 6). This project involves extensive field-based assessment with regard to forest measurements and carbon accounting.
- The UN-REDD Programme[9] is currently developing guidelines for setting RELs and for initial design of MRV systems.
- There are other projects related to REDD+ such as those of the Asian Development Bank, Flora and Fauna International, Conservation International, and CodeREDD.

[7] http://www.nrel.colostate.edu/projects/ALUsoftware/
[8] http://www.giz.de/themen/en/33970.htm
[9] http://www.un-redd.org/

ANNEX D: NATIONAL FRAMEWORK STRATEGY ON CLIMATE CHANGE (NFSCC) PRIORITIES FOR REDD+

The NFSCC's specific strategic priorities in relation to REDD+ as contained in the National Framework Strategy (Climate Change Commission 2011) include:

- Review, harmonize, and, where necessary, formulate enabling policies towards enhancing the forestry sector's ability to reduce emissions from deforestation and forest degradation and enhance carbon stocks, in the process identifying and ensuring social and environmental safeguards are observed in the implementation of REDD-plus.
- Strengthen governance mechanisms in REDD-plus coordination and implementation by establishing appropriate institutional arrangements with which to meaningfully engage stakeholders and ensure equitable benefit sharing with local government units and communities.
- Promote a watershed approach towards REDD-plus planning, implementation, and enforcement, pursuing options to improve protection and sustainable management of forests, and the enhancement of forest carbon stocks and biodiversity.
- Collaboratively establish a broad science-based REDD-plus research and development agenda which, among others, identifies national baselines, the drivers of deforestation and degradation in the country and the social, policy and carbon-cycle aspects of REDD-plus.
- Establish and implement a sub-national REDD-plus measurement, reporting and verification (MRV) system, scaling up to a national level commensurate with the improvement in capacities and resources.
- Formulate and implement a national REDD-plus communication plan and capacity building program with which to facilitate engagement, dialogues and training for stakeholders towards REDD-plus development.
- Explore and capitalize on opportunities for financing REDD-plus, establishing long-term financial sustainability and resilience by seeking multiple funding sources, establishing contingencies and investing in self-sustaining local-level programs.

ANNEX E: SOURCES OF FORESTRY STATISTICS AND INVENTORIES

National Forestry Statistics: National forestry statistics have been published by the Forest Management Bureau since the 1960s. Many of these statistics were based on simple linear projections and extrapolations from the 1965-1969 inventory. In the 1980s more complex projection models were used to generate forestry statistics based on the 1988 RP-German forest inventory. From 1998 onward, FMB stopped making projections to generate forestry statistics, although annual forestry statistics continued to be produced with the caveat that the data published were from 1998.

First National Forest Inventory: The first national inventory was done in 1965-1969. Documentation for this inventory is scanty. The inventory apparently used 1:15,000 scale aerial photographs, which allowed detailed mapping of the different forest categories and segregation into several levels. The inventory included only forestlands, not A&D lands. The sampling design and specific definition of forests used for this inventory are not known.

Second National Forest Inventory: From 1979 to 1983, FAO initiated efforts to conduct a national inventory in the Philippines. Regions 10 and 11 were inventoried using systematically distributed clusters of strip samples. This effort was later continued in 1983 by the RP-German Forest Resource Inventory Project adopting a two-stage inventory design using aerial photographs and satellite images. The project produced stand and stock data of the forest from 1983 to 1988, using forest inventory data collected. The inventory included both forestlands and A&D lands.

This inventory was used as the basis for submitting a national forest cover report to the Global Forest Resources Assessment of FAO for 1990, 1995, and 2000 using simple extrapolation procedures as recommended by FAO.

The forest definition used in this inventory is slightly different from the one used in the third national inventory described below. The threshold definitions of forests for canopy cover and heights of vegetation are similar. The difference is mainly in the minimum area to be considered forest: 1 hectare for the RP-German project and 0.5 hectare for the FRA inventory.

Third National Forest Inventory: This is the 2003 FRA inventory mentioned in Section 5. In this inventory, FMB assumed the responsibility of redefining the national FRI forest classifications, taking into consideration international standards. It essentially adopted the FAO categories used by the Philippines/FAO-assisted National FRA Project. Forest in this inventory was defined as referring to lands with an area of more than 0.5 hectare and tree crown (or equivalent stocking level) of more than 10 percent, and where trees should be able to reach a minimum height of 5 m at maturity *in situ.*

Efforts were made to reconcile the results of the second and third inventories. The inventories yielded different estimates of forest cover because of the differences in the definition of forests, and also the classification or categories of land use. To provide a common estimate of forest cover, the two forest inventories were reconciled.

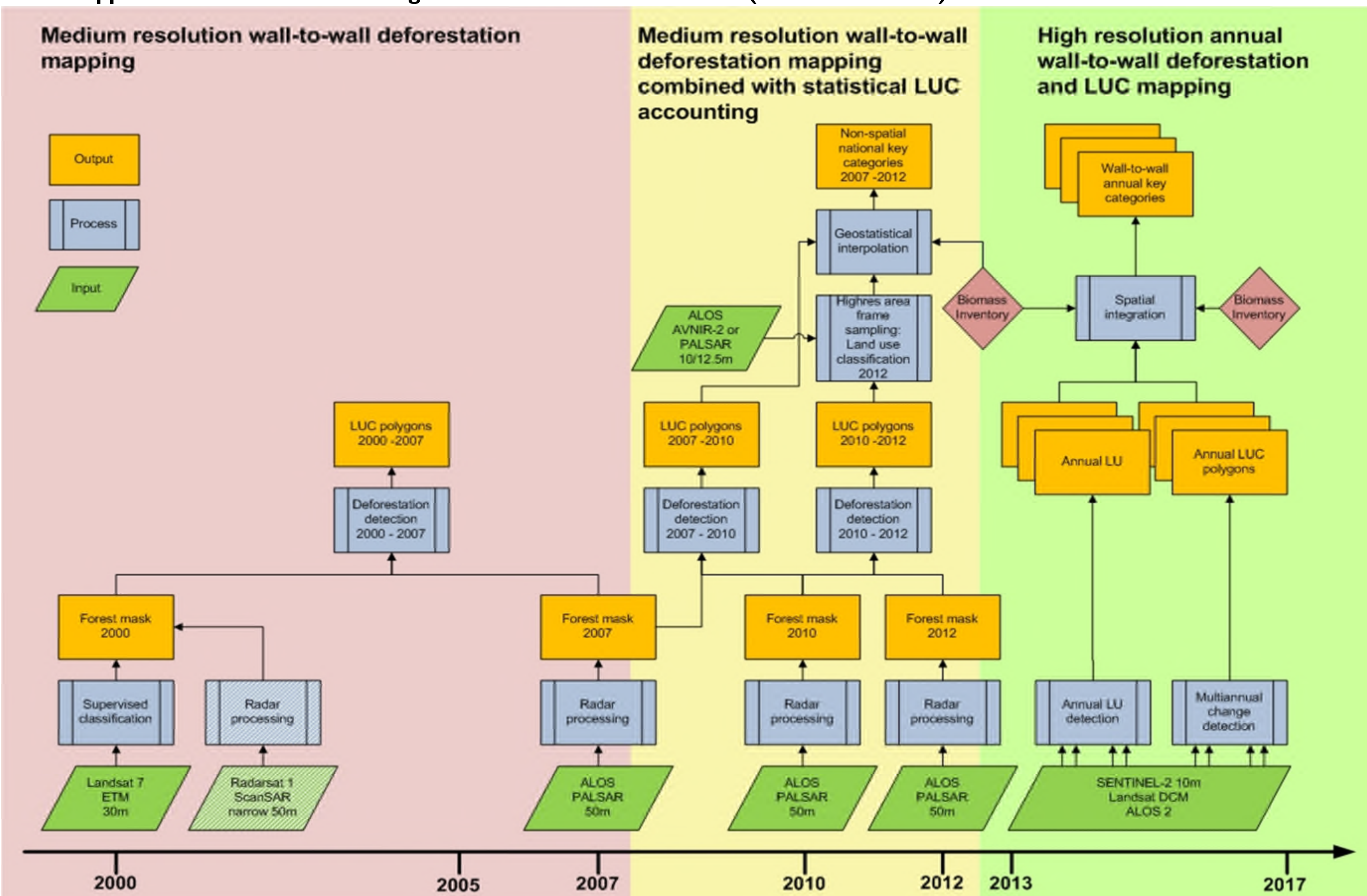
Similarly, NAMRIA and FMB have embarked on an entirely new joint undertaking, with NAMRIA acquiring and combining remotely sensed data, particularly 2000–2003 Landsat ETM images for the country. NAMRIA was tasked to undertake image interpretation, mapping, and statistics generation. To assess accuracy of the mapping process conducted by NAMRIA, the forest inventory plots of FMB's FRA project were overlaid with the land cover maps. This was done by comparing map interpretation with the results of the FRA field sample plots established in various regions of the country. The level of accuracy of the image interpretation was tested and found to be 91 percent. Combining the 2003 FRA estimates with the NAMRIA forest cover maps allowed FMB to make its forest inventory estimate spatial (i.e., the estimates can now be mapped in addition to providing tabular estimates).

Other Forestry Data Compilation: ESSC, in partnership with, and with funding from, the Philippine Tropical Forest Conservation Fund, initially agreed to perform an analysis of Philippine forest cover. One objective of this activity was to generate data providing an acceptable and relatively accurate identification of upland cover for the Philippines for the period 2000–2002. ESSC analyzed remotely sensed data using Landsat ETM+ (2000–2002). In the process, ESSC identified and defined the upland cover of the Philippines based on readily available Landsat satellite imagery for the period 2000–2002; produced a comprehensive documentation of the process undertaken to arrive at the output; and developed map outputs and the estimated forest cover estimates for 2002 (ESSC 2010).

ESSC's estimate for 2002 was about 21.7 percent forest cover, while FMB-DENR's estimate for the same year was at 24.4 percent forest cover (Warpole 2010). This reflects both a slowing down in the rate of deforestation and a diversification in forest degradation. For FMB-DENR, both primary and secondary (closed and open canopy) forest had slightly declined since 1987, while pine forest—along with plantations—had significantly increased to close the gap. The results also show that forest cover had not changed greatly in the last 20 to 25 years, but the type of forest did, particularly in the southern parts of the country (e.g., Cotabato, Davao, Maguindano, Davao del Sur, Basilan, and Zamboanga).

ANNEX F: PROCESS MAP FOR MESA CONSULT PILOT REDD+ PROJECT

Phased approach of the remote sensing workflow at the national level (source: GIZ 2011)



ANNEX G: FORESTRY ASSESSMENT WORKSHOP STAKEHOLDER REVIEW - PARTICIPANTS

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